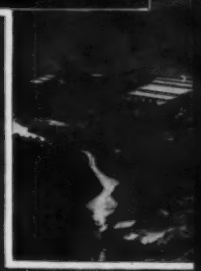
The MINING CONGRESS JOURNAL

Volume 15 NOVEMBER, 1929 *No. 11*



LEAD & ZINC NUMBER

featuring

THE EAGLE-PICHER LEAD COMPANY

Tri-State District Operations

FLOW of LEAD into WORLD TRADE

IMPORTANCE of LEAD and ZINC in INDUSTRY

LEAD INDUSTRY of IDAHO

ZINC RESEARCH and MARKET BROADENING

TRI-STATE DISTRICT from the AIR

RECENT DEVELOPMENTS in TRI-STATE MILLING PRACTICE

ACCIDENT PREVENTION in the TRI-STATE DISTRICT

The IDAHO SCHOOL of MINES

PHELPS DODGE'S NEW LEAD SMELTER

GATHERING HAULAGE METHODS with MECHANICAL LOADING

COAL RESOURCES of the NORTHWEST

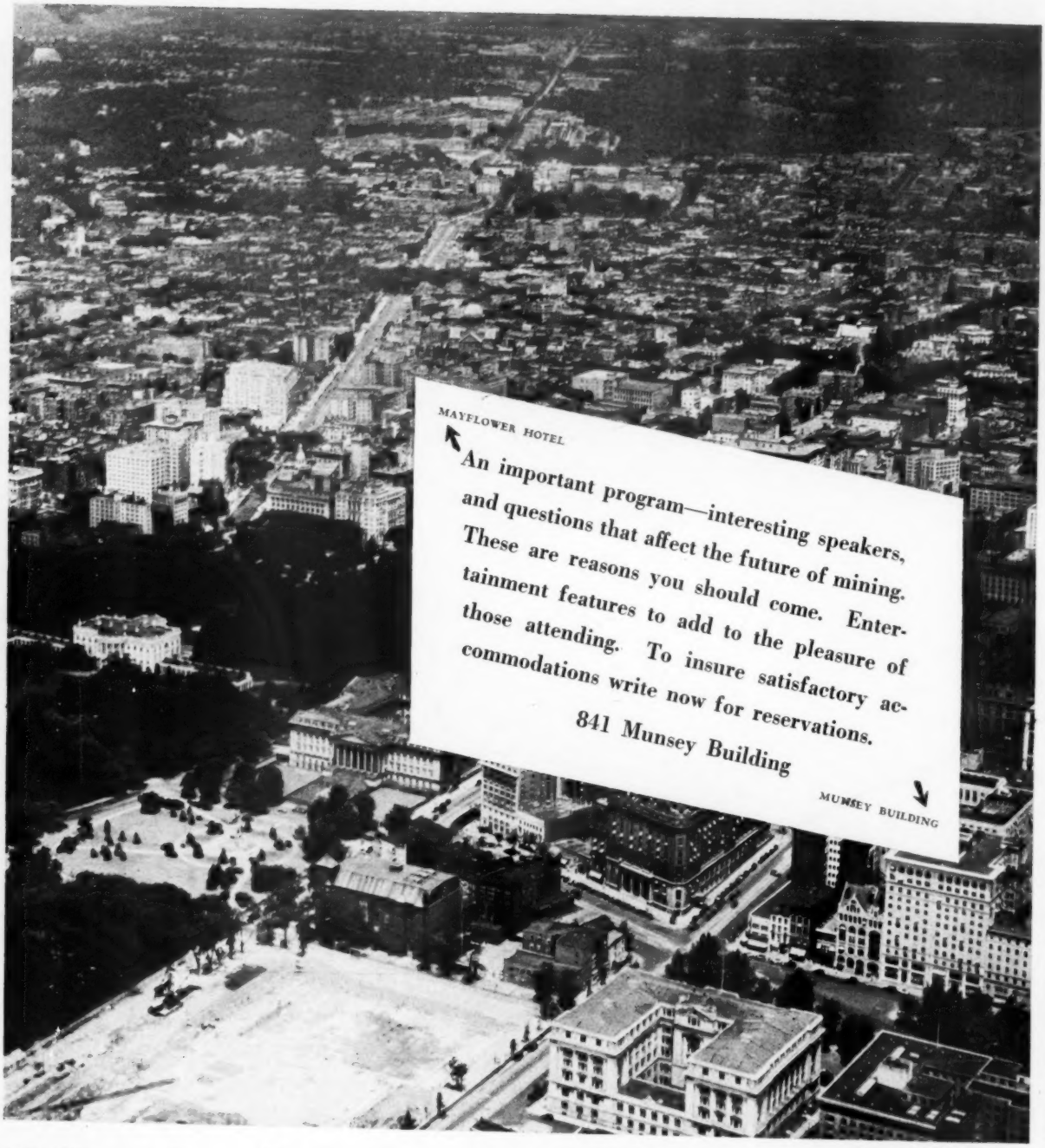
The WESTERN MINING CONVENTION

CONTRIBUTORS:

Elmer W. Pehrson, A. P. Cobb, Ralph M. Roosevelt, Stanly A. Easton, Theodore Marvin, C. F. Williams, C. O. Anderson, H. W. Giessing, A. E. Bendelari, R. K. Stroup, S. S. Clarke, F. W. Sansom, O. N. Wampler, R. E. Illidge, Harold E. Lee, J. Owen Ambler, G. B. Southward, George Watkin Evans.

V 15 11 1 NOV 29 XU

Come to Washington


MAYFLOWER HOTEL
An important program—interesting speakers, and questions that affect the future of mining. These are reasons you should come. Entertainment features to add to the pleasure of those attending. To insure satisfactory accommodations write now for reservations.
841 Munsey Building
MUNSEY BUILDING

©FAIRCHILD AERIAL SURVEY

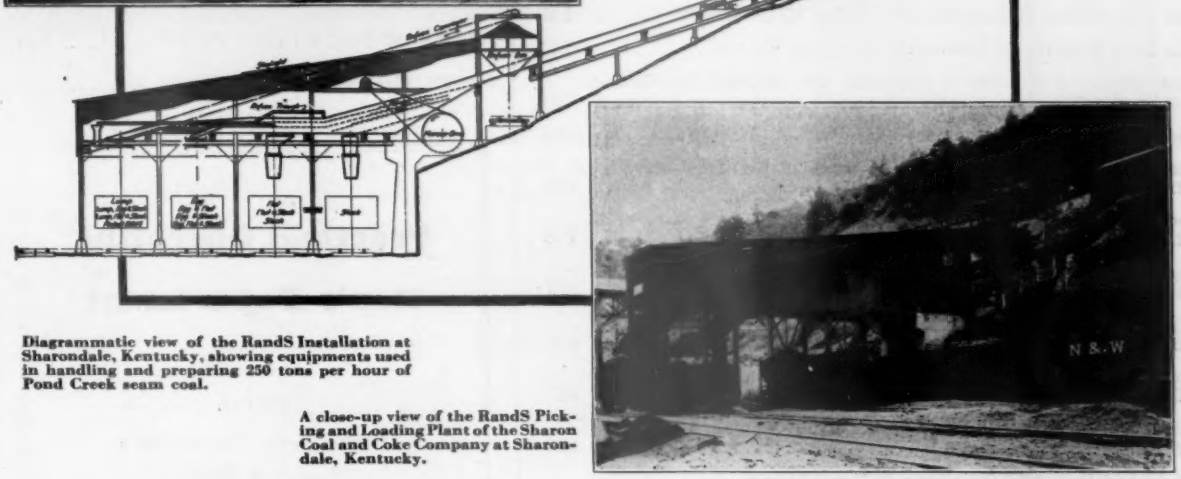
32nd Annual Convention

The AMERICAN MINING CONGRESS

December 4--5--6--7

The 110' Marcus Retarding Conveyor and Picking Table Screen at the Sharondale Tipple - - Exclusive RandS Design.

A general view of the 250-ton per hour Mine and Cleaning Plant of the Sharon Coal and Coke Company, Sharondale, Kentucky.



Diagrammatic view of the RandS Installation at Sharondale, Kentucky, showing equipments used in handling and preparing 250 tons per hour of Pond Creek seam coal.

A close-up view of the RandS Picking and Loading Plant of the Sharon Coal and Coke Company at Sharondale, Kentucky.

The building in of proved methods — not the adapting of standard units — is the work of RandS Engineers, as witnessed here by the 250-ton per hour Sharondale, Kentucky, Plant of the Sharon Coal and Coke Company.

Coal is delivered in cars at the top of the incline and dumped by means of a cross-over dump into a receiving hopper, from which it is fed by a reciprocating feeder to a combination Marcus unit which acts as a conveyor at the upper end and as a screen and picking table at the lower or loading end. The conveying end of the Marcus is 110′ long and inclined at 18°. The screen end is four decked with egg, nut and slack lip screens. The lump coal is picked on the top deck, the egg split into two streams and baffled off on to 3′ wings where it is picked. The lump and egg coal are loaded and lowered into gondola cars by means of apron loading booms. The nut and slack are loaded with chutes. All sizes and combinations of sizes can be loaded on any of 4 tracks.

Pickings are collected in troughs connected to the Marcus Picking Table Screen and carried to a flight conveyor which discharges into a small bin on the hillside for further disposal by mine car or larry.

The conveying and screening unit is operated by a Number 10 Marcus Drive Head using a 40 horsepower motor. *Only 60 horsepower* is required for complete operation of this 250-ton per hour plant, which is of steel construction throughout.

Let our engineers help you secure ultimate efficiency in your plant with RandS Handling, Cleaning and Preparing equipment.

ROBERTS AND SCHAEFER CO.

ENGINEERS and CONTRACTORS

PITTSBURGH, PA., 418 OLIVER BLDG. WRIGLEY BUILDING, CHICAGO HUNTINGTON, W. VIRGINIA, 514 NINTH AVE.

The MINING CONGRESS JOURNAL

VOLUME 15 NOVEMBER, 1929 No. 11

Contents

EDITORIALS

Lead in Industry 831
Zinc in Industry 831
Tariff Bill Prospects 831
Creating an Artificial Sympathy .. 831
Pay Him Higher Wages 832
Benefitting Humanity 832
The Lobby Investigation 832
Facts and Votes 833
Blue Sky Laws and Mine Development 833
When is a Benefit Not a Benefit? .. 833
Per Capita Output in Industry 833
Mine Accidents and Fatalities 834
A Boomerang Principle 834
Short Cuts in Government Procedure 834

FEATURE ARTICLES

Page

Flow of Lead into World Trade in 1928—By Elmer W. Pehrson. 835
The Importance of Zinc in Industry—By A. P. Cobb 840
The Use of Lead in Industry—By Ralph M. Roosevelt 841
The Lead Industry of Idaho—By Stanly A. Easton 842
American Zinc Institute's Research and Market Broadening Plan—By Theodore Marvin 843
The Tri-State District from the Air—By C. F. Williams 846
Recent Developments in Milling Practice in the Tri-State District—By C. O. Anderson 849
Accident Prevention in the Tri-State District—By H. W. Giessing 853
Eagle-Picher—A Large Factor in the Lead Industry—By A. E. Bendelari 857
Exploration Methods at The Eagle-Picher Lead Company—By R. K. Stroup 860
Surface Plant at a Typical Operation of The Eagle-Picher Lead Company—By S. S. Clarke 865
Milling Practice at The Eagle-Picher Lead Company—By F. W. Sansom 869
Safety and Industrial Relations at Eagle-Picher—By O. N. Wampler 876
Tri-State District Mining Methods—By R. E. Illidge 879
The Idaho School of Mines—By Harold E. Lee 885
Phelps Dodge Corporation's New Lead Smelter—By J. Owen Ambler 890
Gathering Haulage Methods With Mechanical Loading—By G. B. Southward 895
The Coal Resources of the Northwest—By George Watkin Evans 898
Western Mining Convention 904

DEPARTMENTS

Page

LEGISLATIVE REVIEW 889
PRACTICAL OPERATING MEN'S DEPARTMENT, METAL 890
REPORTS ON THE MECHANIZATION SURVEY 895
PRACTICAL OPERATING MEN'S DEPARTMENT, COAL 898
NEWS OF THE MINING FIELD 910
WITH THE MANUFACTURERS 918

Practical Operating Men's Department

METAL

Phelps Dodge Corporation's New Lead Smelter

COAL

The Coal Resources of the Northwest

Published Every Month by The American Mining Congress, Washington, D. C.

Edited under the supervision of James F. Callbreath, Secretary of The American Mining Congress

E. R. COOMBES, *Editor*

GUY N. BJORGE, *Associate Editor*
M. W. KRIEGH, *Assistant Editor*
ERNEST H. PULLMAN, *Legislative Editor*
WALTER LUKEI, *News Editor*
NEWELL G. ALFORD, *Associate Editor*
F. E. PRIOR, *Art Editor*
J. M. HADLEY, *Production Manager*
C. J. NUTTALL, *Field Representative*
J. R. HURLBURT, *Advertising Manager*

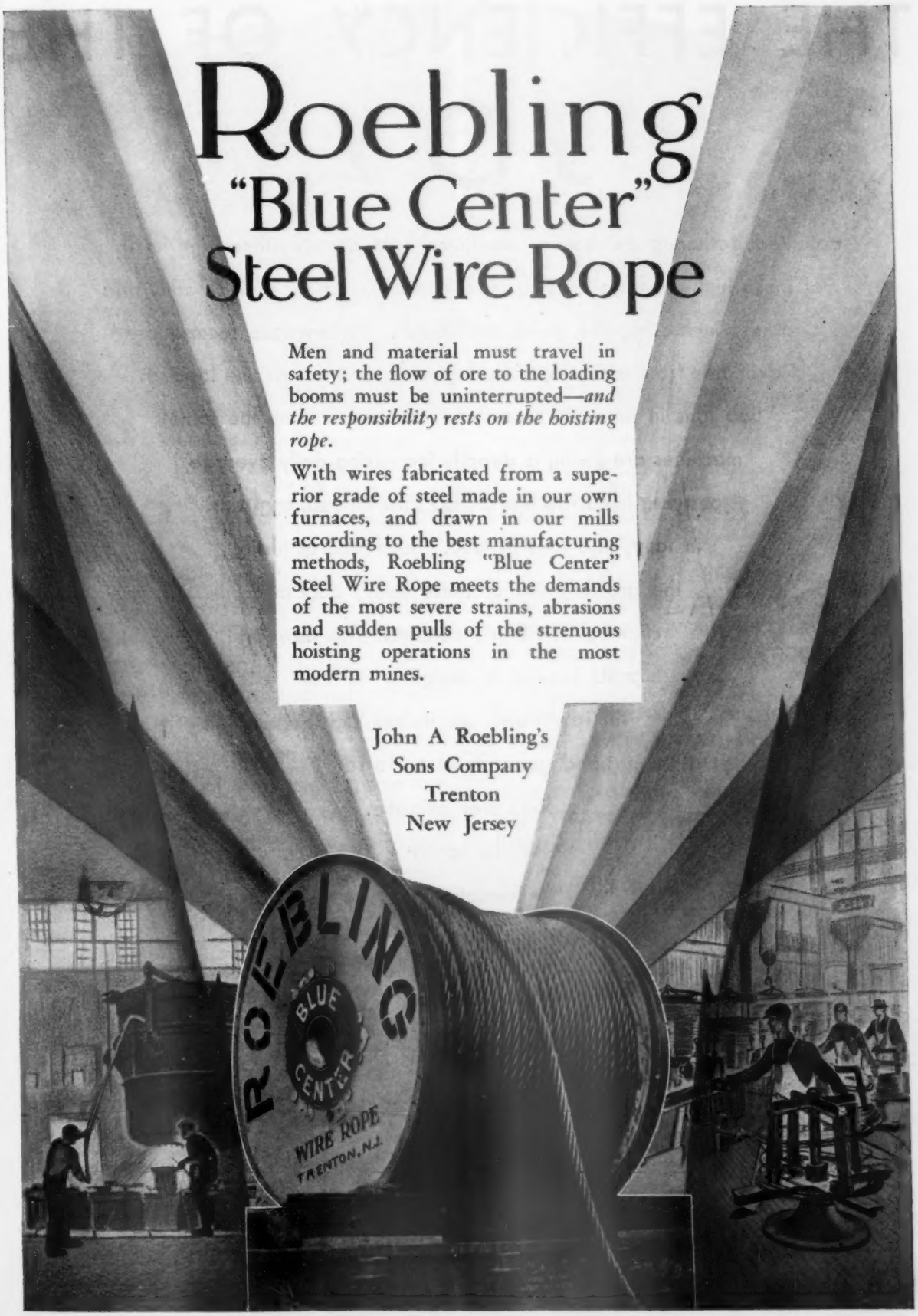
Copyright 1929 by The American Mining Congress. Entered as Second Class Mail Matter January 30, 1915, at the Post Office at Washington, D. C.
YEARLY SUBSCRIPTION, UNITED STATES AND CANADA, $3.00
FOREIGN, $4.00; SINGLE COPIES, $0.30
SINGLE COPIES THIS ISSUE, $1.00

Roebling
"Blue Center" Steel Wire Rope

Men and material must travel in safety; the flow of ore to the loading booms must be uninterrupted—*and the responsibility rests on the hoisting rope.*

With wires fabricated from a superior grade of steel made in our own furnaces, and drawn in our mills according to the best manufacturing methods, Roebling "Blue Center" Steel Wire Rope meets the demands of the most severe strains, abrasions and sudden pulls of the strenuous hoisting operations in the most modern mines.

John A Roebling's
Sons Company
Trenton
New Jersey

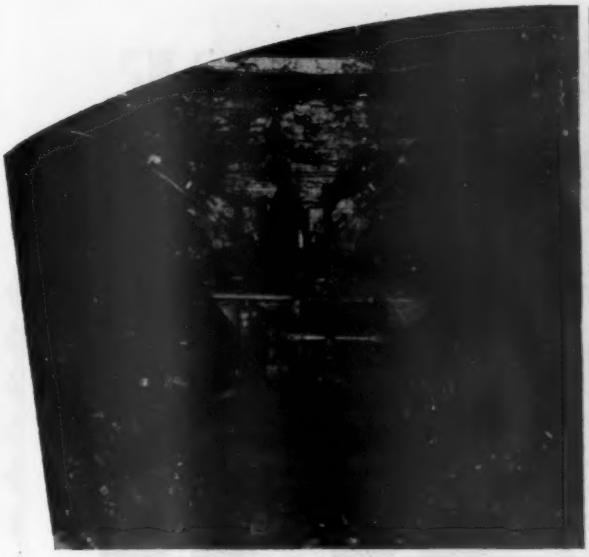


THE EFFICIENCY OF THE JOY

patented gathering mechanism combined with the sturdiness and flexibility of these high tonnage loading machines accounts for their steadily and rapidly increasing use in all coal fields. Performance records are available from ten coal producing states. One machine loaded 860 tons in an eight hour shift. In another mine the same machines are giving a steadily increasing daily average per year in narrow work—197 tons in 1926, 233 tons in 1927, 246 tons in 1928. Such records justify the growing use of these heavy duty mechanical loading machines. The new 7-BU Loader is designed for use in low coal, 40 inches high and guaranteed to load 2 tons per minute.

◆ Write for information. ◆

JOY MANUFACTURING CO., FRANKLIN, PA.



Jeffrey 56-A Drilling Machine drilling near the roof.

Jeffrey 56-A Drilling Machine tramming under its own power.

Faster Drilling—More Lump Coal

Speedy and flexible are the twin drills on the Jeffrey 56-A Drilling Machine. The drills, independently driven, can be worked singly or simultaneously. Their job is to cut costs—and they do.

Under its own power, the machine trams its way to the face, drills are swung into position, and the holes drilled. No unloading, no lifting, no heaving — the self-contained and self-propelled machine does this work.

Then as quickly as it entered, the machine propels itself into the clear, out of the way—everything in readiness for the next operation.

Holes are drilled parallel to natural cleavage and bedding planes eliminating excessive shattering of coal when shooting. Increased percentage of lump coal results.

By writing today, you can learn of many more important advantages the 56-A Drilling Machine offers. No obligation of course.

The Jeffrey Manufacturing Company

958-99 North Fourth St., Columbus, Ohio

BRANCH OFFICES: New York Philadelphia Pittsburgh Scranton, Pa. Charleston, W. Va. Chicago Denver Salt Lake City birmingham
SALES AND SERVICE STATIONS: Pittsburgh, 600 Second Avenue Scranton, 122 Adams Avenue Terre Haute, Ind., 319 Cherry Street
Birmingham, 1900 Avenue A Winchester, Ky., 122 North Main Street Salt Lake City, 153 West Second South Street
Jeffrey Manufacturing Company, Ltd., of Canada. *Head Office*, Montreal; *Branch Office*, Toronto; *Service Station*, 210 Ninth Ave. W., Calgary

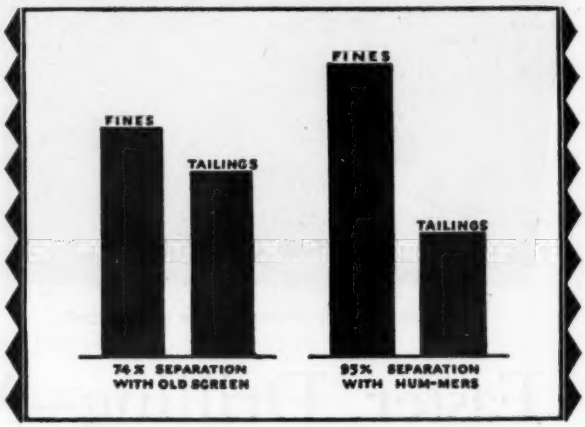
JEFFREY COAL MINE EQUIPMENT

COMPARE THESE SEPARATIONS!

NOTE that the Hum-mer produced a 95% separation as compared to the former separation of 74%. This means that 21% of material formerly left in the tailings is now recovered by the Hum-mer.

Based on the former production of fine material, this is an increase in tonnage of more than 28%.

This is only one of hundreds of instances where the Hum-mer has proved its ability to make screening more profitable.

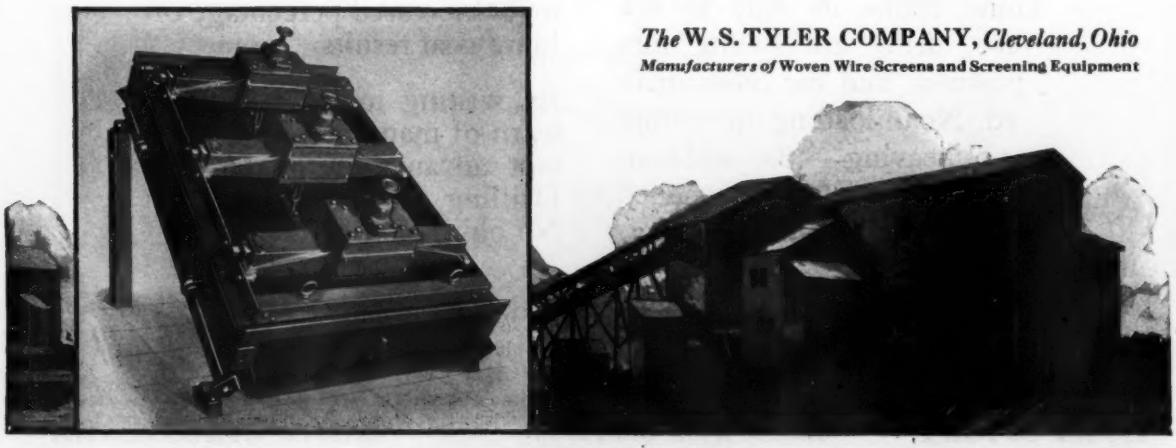


Screen vibration so positive, so powerful, that a man can stand upon the screening surface without diminishing the vibration is responsible for the wonderful sorting action obtained with the Hum-mer.

The "pull" that produces this wonderful vibration is the same as that of the electro-magnetic hoist which is capable of lifting tons of metal.

Learn what the Hum-mer will do on your coal. Send for the book, "Screening for Profit."

The W. S. TYLER COMPANY, *Cleveland, Ohio*
Manufacturers of Woven Wire Screens and Screening Equipment



HUM-MER *Electric* SCREEN

Cutter Bar on Jeffrey 29-C Arcwall Quickly and Easy Controlled

Skinny: Here is another of them hootenannies; what the heck is this for?

Bill: That is to swing the cutter bar around quickly over to the rib or swing it to make it miss posts or to get through tight places along the track. You just push the handle one way and off goes the cutter bar in one direction; push it around the other way and back it comes. You don't have to stop any motor or throw any clutches, just turn the handle. You can't make a mistake.

Skinny: Talkin' about makin' mistakes, I will tell you a good one. I was over at Skeleton Hollow the other night, the boys had a little celebration over there—Bill Syke's mother-in-law had just died—an' I didn't get home until about 3 GM. I came sneakin' in an' a burglar fell out of the house just as I got there.

Bill: Did he get anything?

Skinny: I'll tell the world he did; the poor sucker is in the hospital—my wife thought it was me.

We will be glad to send you a complete description of the many features of the Jeffrey 29-C Arcwall Machine

The Jeffrey Manufacturing Company
958-99 North Fourth St., Columbus, Ohio

BRANCH OFFICES:

New York, Philadelphia, Salt Lake City, Pittsburgh, Scranton, Pa.
Charleston, W. Va., Denver, Birmingham, Chicago

SALES AND SERVICE STATIONS:

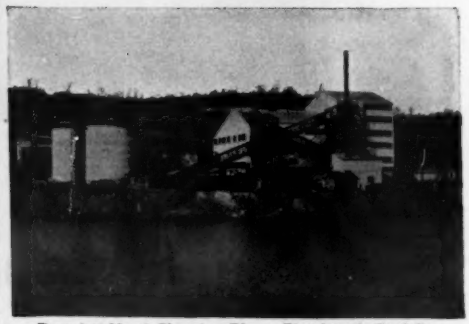
Birmingham, Ala., 1900 Avenue A. Pittsburgh, 600 Second Ave. Scranton, 122 Adams Ave.
Terre Haute, Ind., 319 Cherry St. Winchester, Ky., 122 N. Main St. Salt Lake City, 153 W. Second South St.

JEFFREY MFG. CO., LTD., OF CANADA:
Head Office, Montreal; Branch Office, Toronto; Service Station, 210 Ninth Ave. W., Calgary.

JEFFREY COAL MINE EQUIPMENT

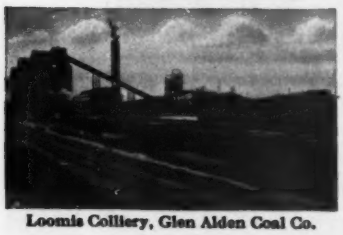
Warden Cleaning Plant, Pittsburgh Coal Co.

Black Diamond Washery, Pacific Coast Coal Co.



Banning No. 1 Cleaning Plant, Pittsburgh Coal Co.

Champion Cleaning Plant, Pittsburgh Coal Co.



Loomis Colliery, Glen Alden Coal Co.

Koppers-Rheo Washery
Great Valley Anthracite Corporation

Cokedale Washery
American Smelting and Refining Co.

The RHEOLAVEUR COAL WASHING PROCESS *is helping these well-known producers to*

{1} Satisfactorily meet the precise specifications of the individual coal buyer.

{2} Standardize subsequent deliveries to that individual buyer.

{3} Obtain increased yield of marketable coal with a greater proportion of larger sizes,—a higher realization in dollars per ton.

{4} Obtain low investment in preparation plant and low operating costs consistent with high washing efficiency and substantial, low-maintenance cost structure and equipment.

The broad experience of the Koppers-Rheo organization is always at your call, why not have one organization,—Koppers-Rheo—assume full responsibility for the investigation, design, construction and initial operation of your next Preparation Plant? You can depend upon having a "Modern" plant if it is a Rheo plant.

KOPPERS-RHEOLAVEUR COMPANY

1150 KOPPERS BUILDING · PITTSBURGH, PENNA.

Sales Office
120 Broadway, New York, N. Y.

First National Bank Building
Huntington, W. Va.

Sales Office and Laboratory
Coal Exchange Building, Wilkes-Barre, Pa.

American Traders Bank Building
Birmingham, Ala.

Cutting Cost per Ton of Production

Lighting the Way to Lower Headlight Costs

Type MS Headlight

With this headlight, the motorman need not worry about light-failures. Ordering information is found on page 54 of the O-B Catalog Supplement No. 2. The Type MB Headlight, a smaller but none-the-less sturdy headlight, is found on page 55 of the same catalog supplement.

Eleven Point Two

11-2 years is the average service record of the men who produce Dirigo Insulation. With this fact in mind and the recognition of the skill that is acquired through long years of service, you who deal with the human element and labor turnover, now will readily understand one of the reasons why O-B Dirigo Insulation ranks with the world's best.

SUDDEN stops, and supply materials shifting onto headlights, derailments, jolts, and jars—these are some of the operating conditions to which headlights are subjected when in mine service. In view of this hard service, is there anything which is likely to take a heavier toll in repairs and replacements than headlights?

It is no wonder then that those who drive hard to lower the cost per ton of production select O-B Headlights as a means for reducing replacement costs! For O-B Headlights are practically unbreakable, and will withstand the heavy impacts of mine service. Furthermore, special vibration springs support the lamp socket and absorb the shocks received by the case, and add many additional days to the life of the lamp. These are a few of the reasons why O-B Headlights light the way to lower headlight costs and better headlight service. These are a few of the reasons why every man, vitally interested in making more profit from mining, will want the complete story of O-B Headlights. A request for Bulletins Nos. 139D and 127D will bring this information to you free of charge.

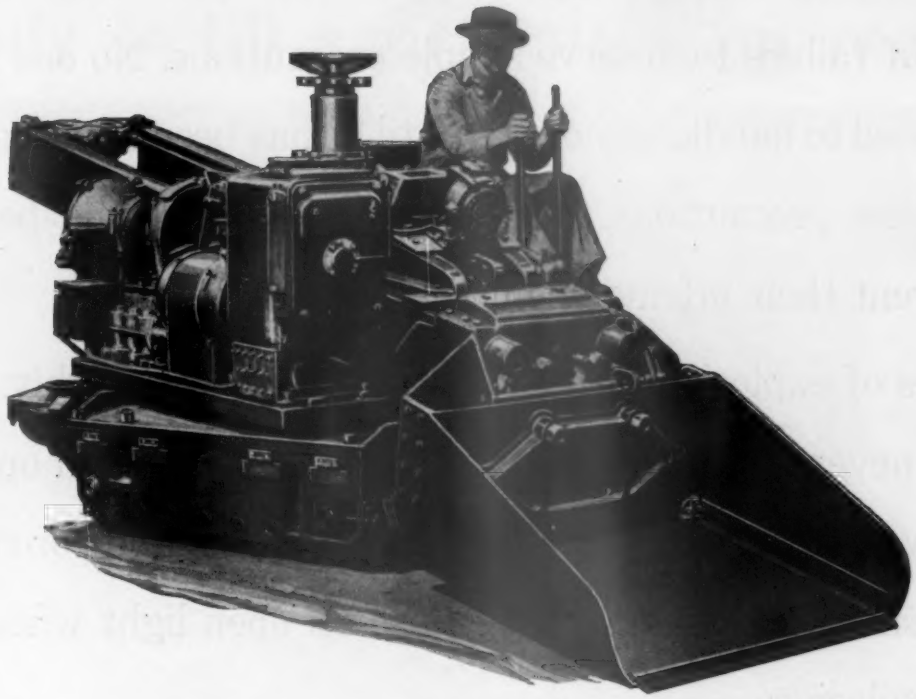
Ohio Brass Company, Mansfield, Ohio
Canadian Ohio Brass Company, Limited
Niagara Falls, Canada
1100M

Ohio Brass Co.

NEW YORK PITTSBURGH PHILADELPHIA BOSTON CHICAGO CLEVELAND ST. LOUIS ATLANTA SAN FRANCISCO LOS ANGELES DALLAS

PORCELAIN INSULATORS
LINE MATERIALS
RAIL BONDS
CAR EQUIPMENT
MINING MATERIALS
VALVES

POWERFUL



The Goodman Power Shovel. Scoop in Withdrawn and Lowered Position, Ready to Pick up Load

It's Simple Cycle: THRUST—LIFT—SWING—DISCHARGE, all in one continuous operation, exactly as a Giant might wield a half-ton shovel. A full circle of 360 degrees, if desired.

It's Electro-Hydraulic!

HOW it handles lumps as large as can be passed through the tipple!

HOW it gobs rock and slate—chunks weighing several tons!

HOW it "picks" down loosened coal not rolled out by the shot!

HOW it digs into a pile of coal, comes up with a half-ton load, swings to the car, discharges and returns to the pile—a matter only of seconds—

ALL of these, and many other features, are explained, and illustrated by mine photographs, in

Book 270—Mailed on Request. It's worth seeing!

(11)

GOODMAN MANUFACTURING COMPANY
HALSTED ST. at 48TH.
CHICAGO - - - ILL.

Locomotives - Loaders - Coal Cutters

PITTSBURGH-WILKES-BARRE-HUNTINGTON, W.VA.-CINCINNATI-BIRMINGHAM-ST. LOUIS-DENVER-PRICE, UTAH

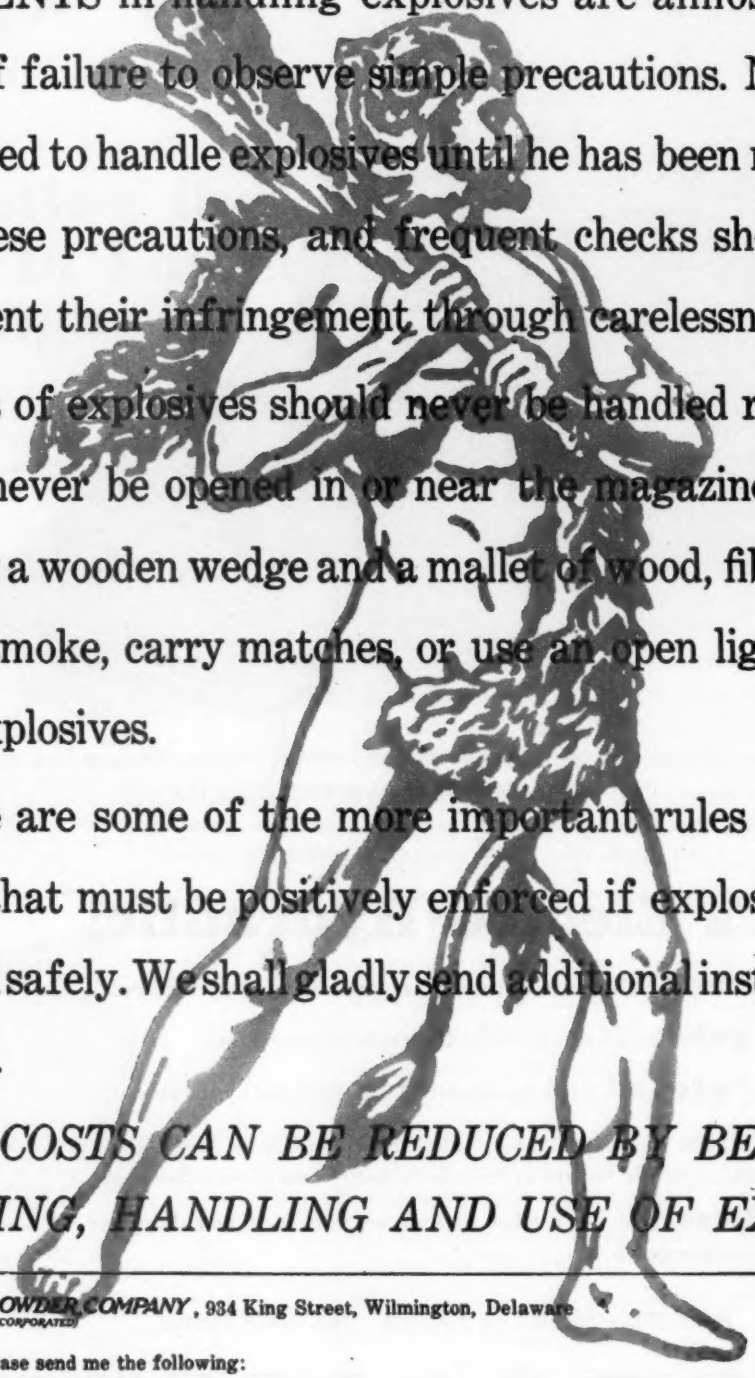
THE RIGHT WAY TO HANDLE EXPLOSIVES

ACCIDENTS in handling explosives are almost always the result of failure to observe simple precautions. No one should be allowed to handle explosives until he has been made familiar with these precautions, and frequent checks should be made to prevent their infringement through carelessness.

Boxes of explosives should never be handled roughly. They should never be opened in or near the magazine. In opening, use only a wooden wedge and a mallet of wood, fibre, or rubber. Never smoke, carry matches, or use an open light when handling explosives.

These are some of the more important rules but there are others that must be positively enforced if explosives are to be handled safely. We shall gladly send additional instructions upon request.

COSTS CAN BE REDUCED BY BETTER STORING, HANDLING AND USE OF EXPLOSIVES



HERCULES POWDER COMPANY (INCORPORATED), 934 King Street, Wilmington, Delaware

Gentlemen: Please send me the following:

☐ Other advertisements of this series which are suitable for bulletin board posting.

☐ Large linen poster of explosives handling and use rules.

☐ Best Practices Handbook

☐ 1928 *Explosives Engineer* index of drilling and blasting articles.

Name..... Address.....

2658-2612

◆◆ BEHIND THE PYRAMIDS—11 ◆◆

N C C

Ready to fill your orders on receipt

Sawing and grinding room

WHEN the furnaces are opened after the graphitizing process, the brush blocks are taken out and cleaned. These are now the semi-finished material from which brushes are made, by sawing and grinding to accurate dimensions.

But before these blocks are put into stock, they are tested thoroughly, for electrical resistance, density and hardness, undergoing the same scientific scrutiny that has been applied to all previous manufacturing operations.

Stocks of these blocks, in all grades, are carried in all our factories. Thus, on receipt of an order, finished brushes can be produced quickly by taking brush blocks from these stores, sawing them to approximate dimensions with special carborundum saws and then grinding to tolerances of a few thousandths of an inch on accurate automatic grinding machines.

Where shunts are required additional machinery operations are necessary, before the brushes are ready to receive the copper cable attachment.

Over 60 days have passed since the lampblack was first manufactured for these brush blocks and brushes. About 36 major operations have been carried out, and innumerable minor ones. Scientific tests and controls have been applied at every step. The brush blocks that have been approved by our laboratory and inspection staff are now put into stock awaiting your orders.

An interesting moving picture film illustrating in detail the processes used in the manufacture of carbon brushes will gladly be shown on request to any organization of engineers or students.

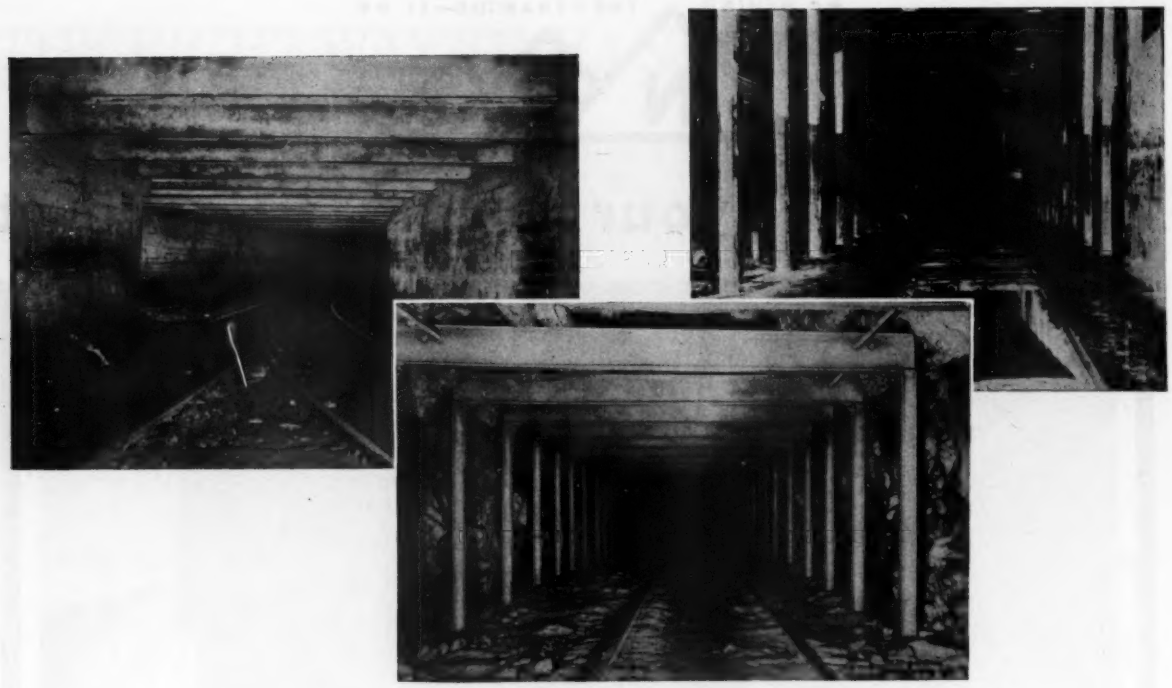
NATIONAL CARBON COMPANY, INC.

Unit of Union Carbide UCC *and Carbon Corporation*

Carbon Sales Division — SILVER STRAND CABLE — Cleveland, Ohio

Branch Offices and Factories

New York Pittsburgh Chicago Birmingham San Francisco



The Ideal Roof Support

HAULAGE WAYS are the vital arteries of a coal mine. Upon their condition depends, to a great degree, the speed with which coal is brought to the surface . . . depends production.

Shown above are views of the Coalwood Mines of the Consolidation Coal Company. Here bad roof conditions prevailed until Carnegie Steel Mine Timbers were installed. The danger of cave-in has now been eliminated, and in this respect, the workmen are as safe in this mine as they would be above ground. Every available inch of space can now be used to its full advantage. Ample room is provided for rapid movement of coal. Heavier loading of cars is possible. The roof problem has been permanently solved.

Carnegie Steel Mine Timbers are especially recommended for use in main entries, shafts, mine stables, pump rooms—in short, at any place where long endurance of the roof is necessary. In some instances Steel Mine Timbers have been installed at a first cost equal to, if not less than that of wood. Conditions at the mine, however, regulate the cost. But that the investment is always economical has been the common experience of users.

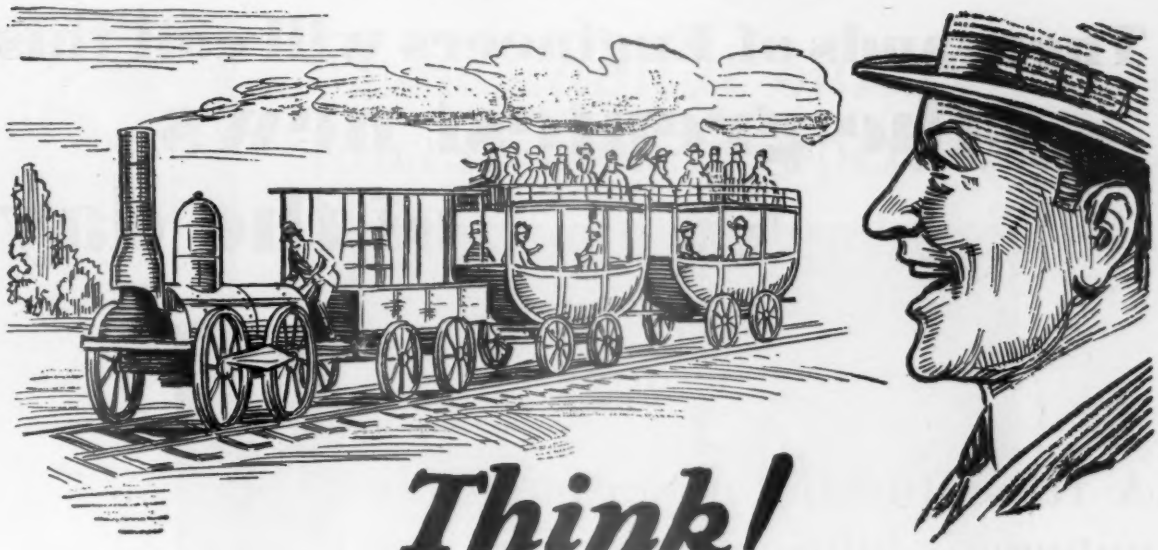
Send for copy of booklet—"STEEL MINE TIMBERS"

CARNEGIE STEEL COMPANY - PITTSBURGH, PA.

Subsidiary of United States Steel Corporation

26

CARNEGIE
STEEL MINE TIMBERS



Think! Before You Laugh

Many a mine operator who would laugh derisively at the suggestion of 18th century transportation for himself or his coal would be sadly shocked by a thoughtful survey of some of his own "modern" mining methods

If he hasn't yet learned that man-power, multiplied by machinery means profits—if he still believes that his old-time coal loading and transportation can compete successfully with the output records of the Cosco Shaker Conveyor System, he hasn't discovered the real reason why his mines aren't making money.

For evidence let us point to the more than 400 successful Cosco installations in American mines—working continuously day in and day out, speeding production, cutting costs, steadily and economically building up the credit side of the ledger.

Coal today has too much competition for any mine owner to content himself with anything less than the latest cost-cutting equipment of proved merit.

Let us give you figures on what the Cosco A-20 or B-15 Drives and Troughing, with improved flanged rollers and "Duckbill" will do for *your* mines.

Cosco Shaker CONVEYOR

CONVEYOR SALES CO., INC.
299 Broadway, New York

DISTRICT SALES OFFICES

PITTSBURGH, PA.
1538 Montier St.
Wilkinsburg

SCRANTON, PA.
Mears Building

HUNTINGTON, W. VA.
1223 Tenth Ave.

KNOXVILLE, TENN.
2725 Magnolia Ave.

COSCO B-15 DRIVE
The Perfected Low Seam Drive

DISTRICT SALES OFFICES

SALT LAKE CITY, UTAH
Salt Lake Hardware Co.

DENVER, COLO.
Stearns Roger Mfg. Co.

PITTSBURG, KANS.

CHICAGO, ILL.
224 So. Michigan Ave.

BIRMINGHAM, ALA.
1802 American Trust Bldg.

"Convey Your Coal the Cosco Way"

Thousands of Engineers will call this the greatest news of the day

A revolutionary new *completely automatic* lubricating system has been perfected!

HERE ARE THE AMAZING THINGS IT DOES—

1. Practically eliminates all repairs and shutdowns due to imperfect lubrication.
2. Reduces power consumption by ⅓ to ½.
3. Increases bearing life by a wide margin.
4. It is completely automatic—the only manual feature being the infrequent filling of the grease tanks.
5. Cuts lubrication bills from 25 to 50%.
6. Soon pays back its reasonable cost by the tremendous savings it effects.

(Let one of our engineers prove every detail of this in you own plant.)

We cannot urge you too strongly to write at once and get the full facts concerning the Keystone Pneuma-Lectric Lubricating System.

We can furnish you with definite, positive proof *on your own machinery* that this remarkable new lubricating system will save you a surprising sum every year.

Since 1884 the Keystone Lubricating Co. has been developing and perfecting new lubricants and new lubricating devices. Many of the most significant and far-reaching improvements in lubrication have originated with this company.

KEYSTONE GREASE

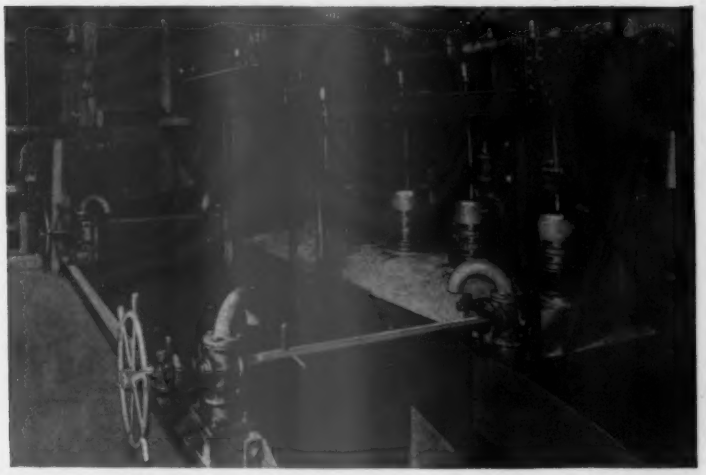
KEYSTONE SAFETY LUBRICATING SYSTEMS

KEYSTONE LUBRICATING CO.

21st, CLEARFIELD AND LIPPINCOTT STREETS, PHILADELPHIA, PA.

ESTABLISHED 1884

"Low capital outlay—lowest cost to operate"



IT is the high capacity attainable with a single unit of the Link-Belt—Simon-Carves Coal Cleaning System, which justifies the heading quoted from a descriptive bulletin.

Due to the use of compressed air (instead of the usual plungers) to produce pulsations within the washing compartment, more than twice the efficiency in separation is secured. Back-suction is eliminated, and air cushioning secures unhindered stratification between pulsations.

The Link-Belt—Simon-Carves System washes coal without presizing, and as coal is cleaned before classifying, it does away with the dry screening, dust nuisance, and degradation resulting from several handlings of the coal.

Write for complete report on service being rendered by the Link-Belt—Simon-Carves Washeries now installed in this country.

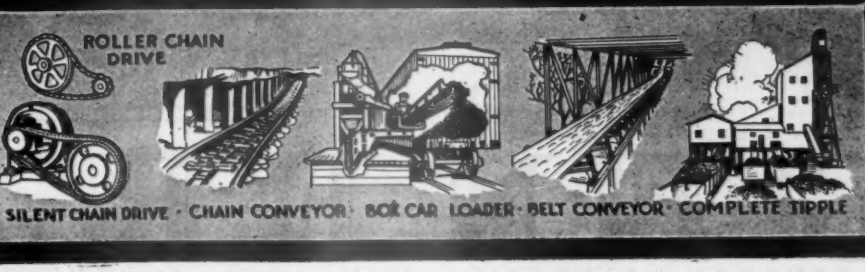
LINK-BELT COMPANY

300 W. Pershing Road CHICAGO

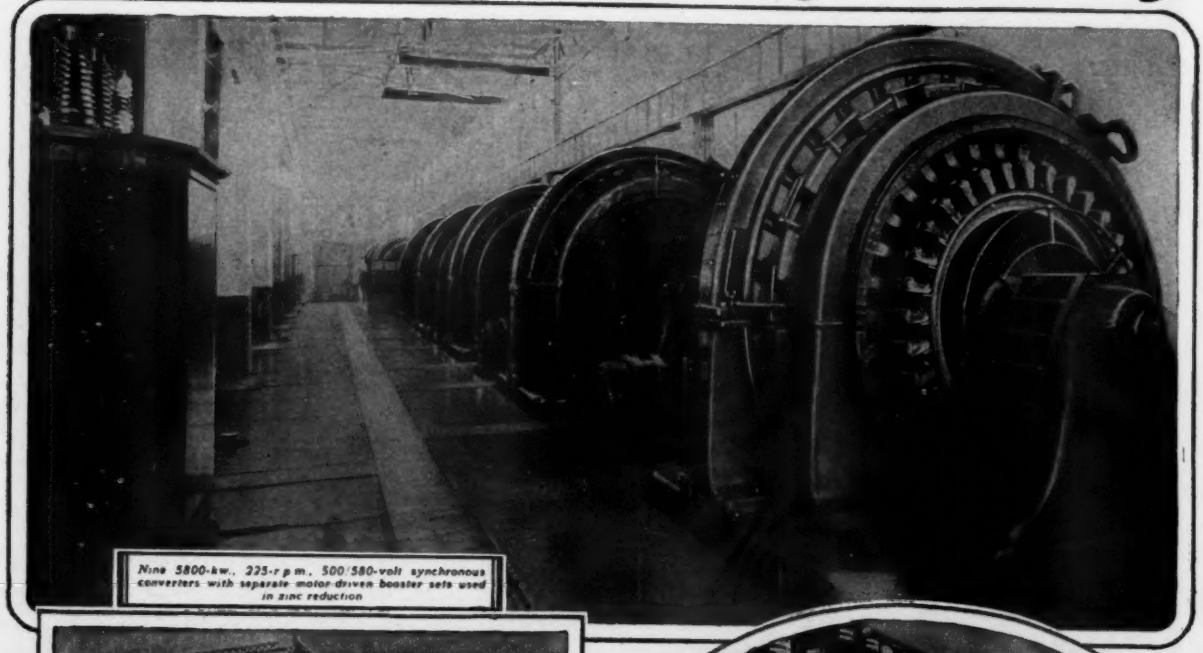
3804

LINK-BELT

SIMON-CARVES WASHERIES

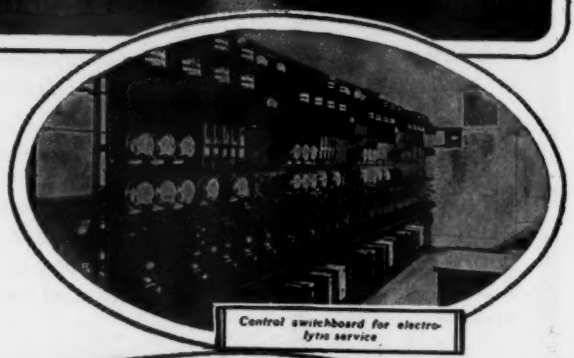


Electric Equipment for Every

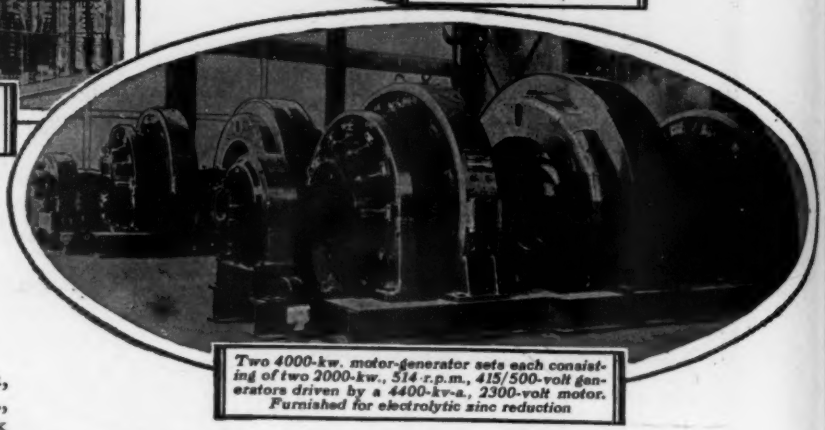


Nine 5800-kw., 225-r.p.m., 500/580-volt synchronous converters with separate motor-driven booster sets used in zinc reduction

110,000-volt outdoor substation for electrolytic plant



Control switchboard for electrolytic service



Two 4000-kw. motor-generator sets each consisting of two 2000-kw., 514-r.p.m., 415/500-volt generators driven by a 4400-kv-a., 2300-volt motor. Furnished for electrolytic zinc reduction

JOIN US IN THE GENERAL ELECTRIC HOUR, BROADCAST EVERY SATURDAY AT 9 P.M., E.S.T. ON A NATION-WIDE N.B.C. NETWORK

GENERAL

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

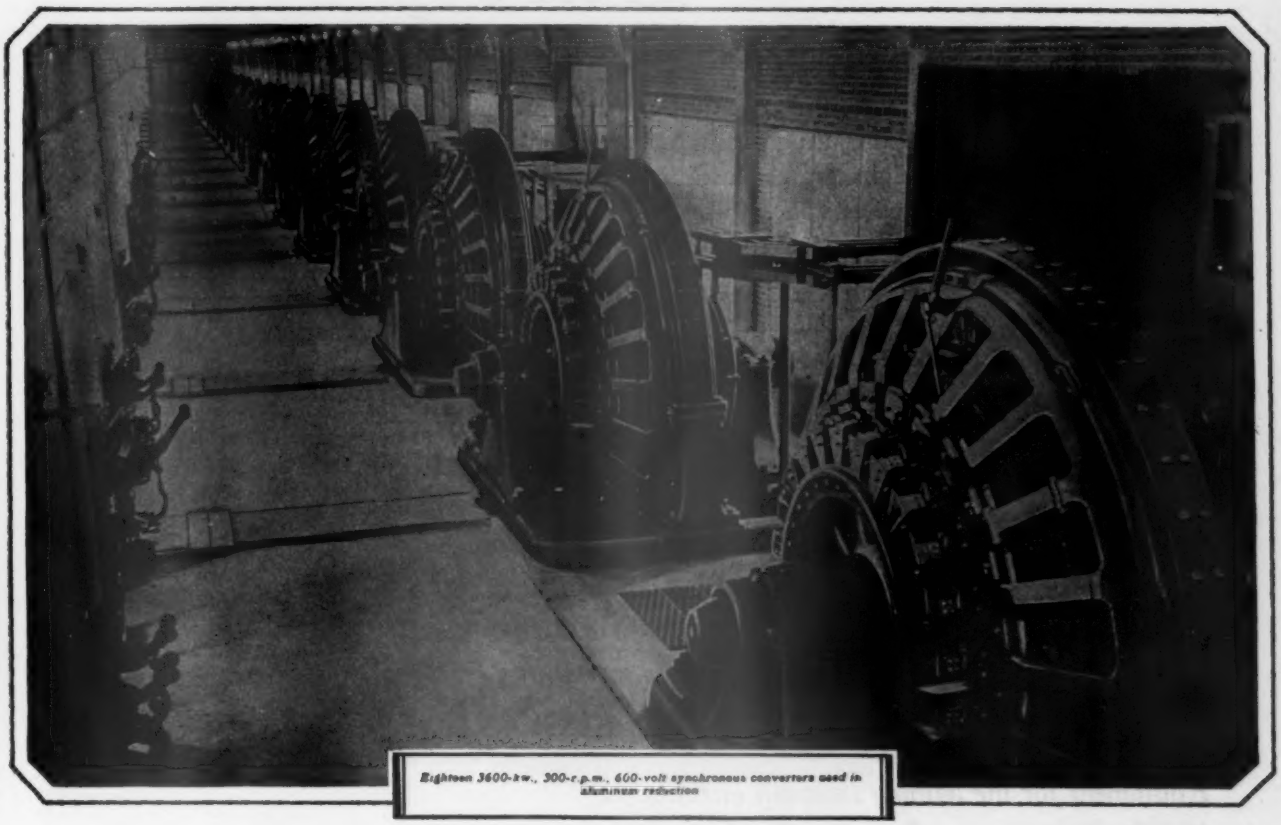
Type of Electrolytic Process

ONE of the most remarkable tributes to the performance of General Electric equipment is its widespread adoption in the electrolytic processes. More than 300,000 kw. in G-E synchronous converters and motor-generator sets for electrolytic service have been installed within the last four years.

General Electric supplies every type of electric equipment involved in the electrolytic processes, from the control for small motor-driven auxiliaries to huge converters and complex switchboards.

Every operating condition is carefully considered in the design of G-E electrolytic equipment with the result that conversion apparatus gives long service with minimum expense for maintenance.

General Electric engineers can advise you concerning problems in the application of electric equipment to the electrolytic extraction and refining of metals. Your nearest G-E office is ready to supply complete information.

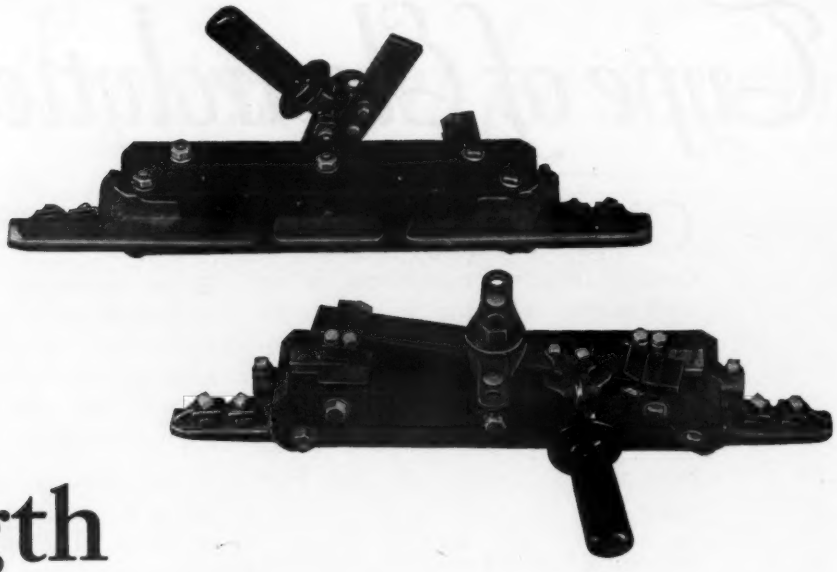


Eighteen 3600-kw., 300-r.p.m., 600-volt synchronous converters used in aluminum reduction

135-2

ELECTRIC

SALES OFFICES IN PRINCIPAL CITIES



Strength and Safety

THE new and improved Double-gap Section Insulator combines both strength and safety. It is of double beam construction and has two air gaps as insulating mediums in the underrun. The beams are made of straight grained hickory, oil impregnated and painted. A hand-operated switch with Moldarta handle is mounted on the top. The blade can be locked open, thereby complying with the compensation law.

The Westinghouse Double-gap Section Insulator is reversible and may be used on either the right—or left-hand side of the track.

Wild trolleys, abuse and rock falls, that would wreck a less sturdy insulator, fail to put the Westinghouse Double-gap Section Insulator out of commission.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY
EAST PITTSBURGH PENNSYLVANIA
SALES OFFICES AND SERVICE SHOPS IN ALL PRINCIPAL CITIES

Westinghouse

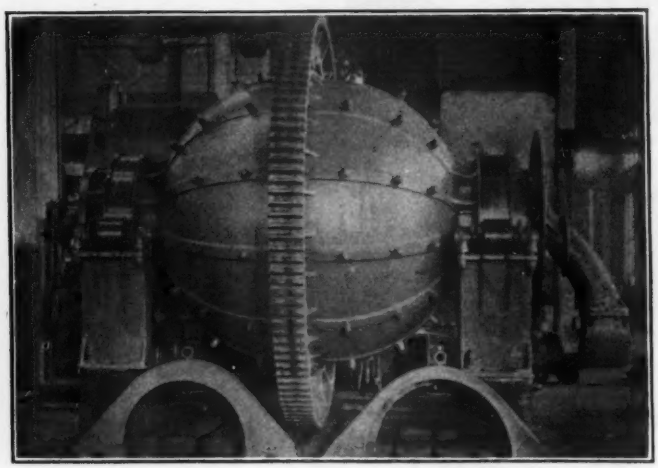
T 30759

Equipment for the Mining Industry includes:

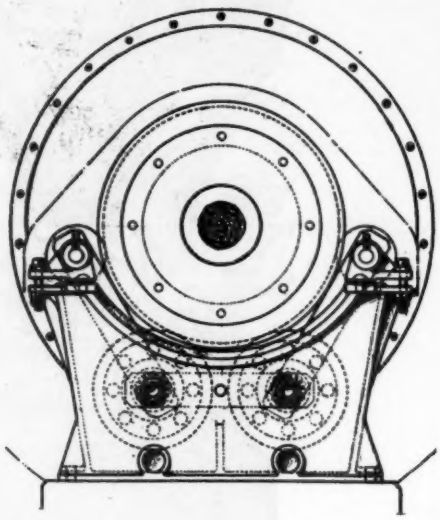
Arc-welding Equipment
Automatic Substations
Automatic Elec. Babbitt Pots
Babbitt and Solder
Circuit-breakers
Condensers
Electric Locomotives
Fans
Floodlights
Gears
Instruments and Meters
Insulating Materials
Lightning Arresters
Line Material
Mazda Lamps
Mine Illumination
Motor-generators
Motors and Control
Panelboards
Speed Reducers
Stokers
Switchboards
Transformers
Turbine-generators

LEAD and ZINC

The "GOOSEBERRY"



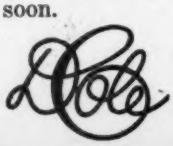
MR. SANSOM has hastened the debut of the new ball mill unexpectedly, making additional information about it in this issue of M. C. J. pertinent. It was designed especially to meet Tri-State Lead Zinc milling conditions. I called it the "Ellipsoidal" mill, but that was too topheavy for Bendelari—who bought the first one and "repeats"—he promptly rechristened it the "Gooseberry" which just exactly fits. I appreciate Sansom's mention, but I like Mr. Bendelari's nickname — THE GOOSEBERRY BALL MILL designed by Cole, let's call it that.



THIS MILL is made symmetrical around both the horizontal and vertical center lines. Excepting the feed scoop and discharge nozzle, it has no right and left parts; everything fits either side up, or either end around;—which is just as easy to do and is common sense.—Exchanging the feed scoop and discharge nozzle reverses the mill; liners fit alike on either end; the gear on the equator is split and reversible. Mill carried on four link supported rollers having two big roller bearings each; eight self-aligning S K F bearings carries 100% of the load, (see cut). The scoop shown in the picture is sufficient "handle" with which to "spin" the empty mill by hand,—for the mill is almost frictionless. Taking out discharge nozzle makes a large opening to enter in examining or changing liners; liners are ribbed to suit customer's taste; made of any material;—for the Tri-State district, of "hard" iron. I prefer gears made of semi-steel, using cast steel pinions with shaped out teeth, to insure proper centering; let them acquire their own polish, but the "GOOSEBERRY" looks a little more stylish with the fancy cut gears if you want to spend the money for them. The pinion shaft with self-aligning bearings on each side of pinion is very sturdy and trouble proof.

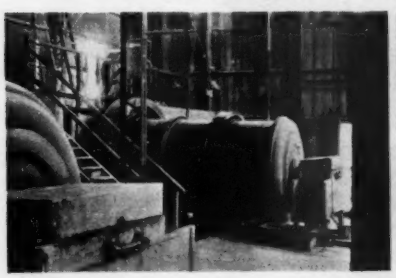
There will be five diameters of GOOSEBERRY BALL MILLS, with cylindrical sections for each size to meet grinding conditions required.—Five diameters of short cylindrical ROD MILLS also, all on interchangeable roller mounting like the above. No literature yet, but soon.

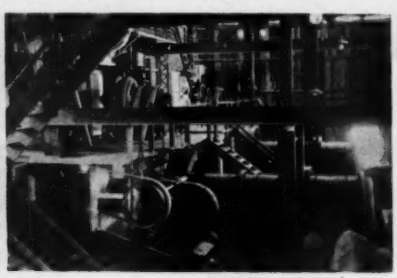
They save power up to 30% and COST NO MORE.



ENGINEER
MILLS BUILDING
EL PASO, TEX.

Cole Rod Mills as first installed, and repeat orders, at Cananea, Mexico. First mill has been in steady operation for more than 6 years.





ANOTHER APPLICATION OF SKF BEARINGS
IN THE MINING FIELD BY

DAVID COLE AT
THE EAGLE-PICHER LEAD COMPANY

YOU MAY BUY A BEARING AS A BARGAIN BUT TRY AND GET A BARGAIN OUT OF USING IT

for

Nothing is apt to cost so much as a bearing that cost so little.

SKF
Puts the Right Bearing in the Right Place

Bought One—Liked It—Got Three More And SKF Bearings Helped Sell Cole Mills

THE headline sums up the experience of Mr. A. E. Bendelari, president of the Eagle-Picher Lead Company with the "Gooseberry Ball Mill," designed by David Cole, Consulting Engineer, and equipped with SKF Self-Aligning Roller Bearings. It's hard, tough going for these mills and the proven performance of the first one "sold" additional units.

The mill is carried on four link-supported rollers with two SKF Bearings per Roller. Therefore, eight SKF Self-Aligning Roller Bearings carry 100% of the load. The scoop at the right end of the mill is sufficient "handle" with which to "spin" the empty mill by hand . . . for the mill is almost frictionless. And that's the reason why the "Gooseberry Mill" saves power up to 30% with the added advantages of uninterrupted performance and long life which characterize SKF installations in the entire mining industry.

SKF INDUSTRIES INC., 40 East 34th Street, New York, N. Y.

2415

SKF
Ball and Roller Bearings

MODERN MINING MACHINERY

ROGERS JAW CRUSHERS

ROGERS JOPLIN

Blake Type Jaw Crushers from 7"x10" to 18"x36" opening.

New features on our large crushers—
Sleeve type water cooled main bearings.
Sleeve type water cooled Pitman bearing.
Spring suspended Pitman.

Our Jaw Crushers have stood the test of 30 years time and are perfected "up-to-date." Hundreds of these crushers are in successful operation and are used almost exclusively in the southwestern lead and zinc mining district.

ALSO MANUFACTURERS OF—

Cornish Geared Rolls
Belt Driven Rolls
Electric Mine Hoists
Mine Cars
Timken Bearing Sheaves
Jig Irons
Elevator Irons
Revolving Screens
Cog-Belt Drives

Let us have your inquiries

ROGERS IRON WORKS CO.

ENGINEERS FOUNDERS MACHINISTS

JOPLIN, MISSOURI

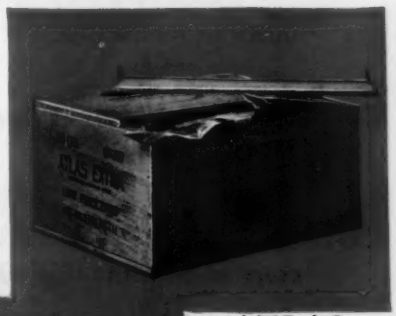
ROGERS JOPLIN

MODERN MINING MACHINERY

ATLAS EXPLOSIVES
AND ACCESSORIES
for LEAD and ZINC Mining

In mining lead and zinc ores it is essential that the explosives used develop a high degree of shattering action. These ores are extremely brittle and this condition is most effectively overcome by blasting with fast-action explosives.

Through wide experience gained in blasting in the Lead and Zinc Districts in all parts of North America, the Atlas Powder Company has found the following types of explosives best adapted for blasting these ores:



ATLAS
L. F. Gelatin

Atlas L. F. Gelatin, in addition to its high fracturing and shattering characteristics, is especially adapted for wet work and for use where the ventilation is poor. Its ready plasticity permits easy priming and loading in uppers.

ATLAS
L. F. Extras

Atlas L. F. Extras are less water resisting and somewhat poorer in fumes envolved than the gelatins but, because they are less dense, they can be used with greater economy wherever good ventilation and fairly dry conditions prevail.

ATLAS L. F. Giant Gelatin

Atlas L. F. Giant Gelatin has virtually the same general properties as the L. F. Gelatin. It is slightly cheaper because part of its explosive ingredient is ammonium nitrate.

Apcodyns 15 and 16

Atlas Apcodyns 15 and 16, detonating at relatively high velocities, have proved themselves to be especially economical in the blasting of the extremely brittle lead and zinc ores.

Atlas accessories for blasting — rheostats, galvonometers, blasting machines, blasting caps, electric blasting caps, delay electric blasting caps, fuse, etc. — are of recognized quality and performance.

ATLAS POWDER COMPANY
Wilmington, Delaware

Branch Offices:

ALLENTOWN, PA.
BOSTON, MASS.
CHARLESTON, W. VA.
CHICAGO, ILL.
DES MOINES, IOWA.
HOUGHTON, MICH.
JOPLIN, MO.
KANSAS CITY, MO.
KNOXVILLE, TENN.

ATLAS EXPLOSIVES

Branch Offices:

McALESTER, OKLA.
NEW ORLEANS, LA.
NEW YORK, N. Y.
NORRISTOWN, PA.
PHILADELPHIA, PA.
PITTSBURG, KANS.
PITTSBURGH, PA.
POTTSVILLE, PA.
ST. LOUIS, MO.
WILKES-BARRE, PA.

V 15 11 1 NOV 29

BUTCHART
MANUFACTURING COMPANY

FLOTATION MACHINES built by us produce 90% of the Zinc floated in the World's Greatest Zinc District.

THICKENERS, of the Standard Round Type, including
OPERATING MECHANISMS and
STEEL SUPERSTRUCTURES.
150 Thickeners built by us in sizes from 10 ft. to 100 ft. diameter furnish 90% of the Flotation Feed treated.

DIAPHRAGM PUMPS made by us handle 95% of the Flotation Feed treated.

CONCENTRATING TABLES made by us are the equipment of every mill built in this district during the past five years.

AUTOMATIC SAMPLERS, pneumatic type, simple and dependable.

CENTRIFUGAL PUMPS, for Sand and Water, hundreds in use.

Sales Agents for

HARDINGE BALL MILLS.
COATES STEEL BALLS.
REDWOOD TANK MATERIAL.
LEAHY VIBRATING SCREENS.
FLOTATION OILS
AND REAGENTS.

JOPLIN, MO.

New Manufacturing Center of the Mid-West and Warehouse of the World's Greatest Zinc District

The Ruby Mine and Mill

One of the 180 horsepower Fairbanks-Morse Diesels.

The 120 horsepower Fairbanks-Morse Engine.

The main mill drive is a 360 horsepower Fairbanks-Morse Diesel.

Lead mine powered with F-M Diesels

Down in Arizona near the border—33 miles by wagon road from the nearest town, Nogales, and 40 miles from a railroad—is the Ruby mine of Montana Mine Operations, a subsidiary of the Eagle Picher Lead Company.

A 180 horsepower Fairbanks-Morse Diesel with alternator furnishes power for the Fairbanks-Morse hoist motor. A 120 horsepower Fairbanks-Morse Diesel drives the crusher rolls, trommel screens and elevators. The two-stage air compressor is driven by a 180 horsepower Fairbanks-Morse Diesel. Current for laboratory and miscellaneous uses is supplied by a 60 horsepower Fairbanks-Morse Diesel generating set. The main mill drive is from lineshaft belted to a 360 horsepower Fairbanks-Morse Diesel.

Out where repair facilities are hard to get—on a job where power must be dependable, this company chose Fairbanks-Morse Diesel Engines.

Fairbanks, Morse & Co., Chicago

32 Branches at your service throughout the United States.

FAIRBANKS-MORSE

DIESEL ENGINES

POWER, PUMPING AND WEIGHING EQUIPMENT

Crushers and Rolls at Eagle-Picher--by WEBB CITY

of course

Webb City crushers and rolls play an important part in the milling operations at Eagle-Picher.

All primary grinding is done on Webb City Blake Type Crushers, while regrinding is efficiently handled on Webb City Cornish and High Speed Rolls.

Years of hard and constant service have proven the ability of these Webb City Crushers to stand up and deliver under the most severe operating conditions.

There is a Webb City & Carterville machine for every rock crushing requirement.

BLAKE TYPE JAW CRUSHER—Designed to crush large material.

STANDARD TYPE CRUSHING ROLLS—Adapted for medium to fine crushing.

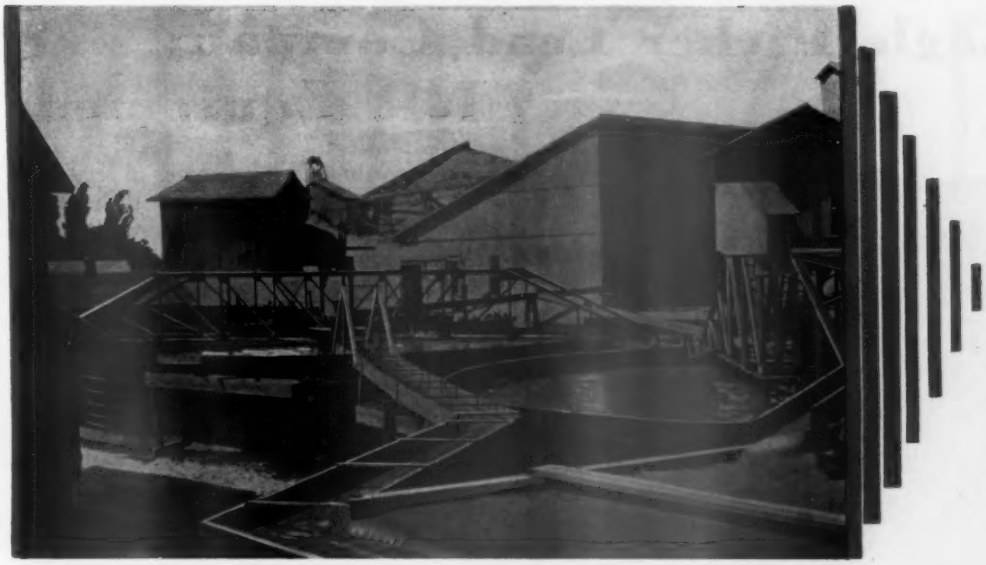
HERCULES TYPE CRUSHING ROLLS—Built for hard rock, coarse crushing and large capacity.

CORNISH TYPE CRUSHING ROLLS—For lower cost crushing service.

Write for catalog

WEBB CITY & CARTERVILLE FOUNDRY & MACHINE WORKS

Webb City, Mo.



DORR EQUIPMENT
in Eagle-Picher Plants

Agitators
Classifiers
Thickeners
Filters
Washers
Sand Washers
Slurry Mixers
Clarifiers
Screen Units
Detritors
Digesters
Pumps
Valves
Sizers

DORRCO

THE DORR THICKENERS shown here are only some of the many units that are in operation at Eagle-Picher Lead Company plants. And many other lead-zinc companies in the Joplin and Flat River Districts and also in Canada, are operating Dorr Thickeners for dewatering concentrates or tailings.

In addition to Dorr Thickeners the Eagle-Picher Company operates a Dorrco Filter, Dorr Classifiers and Dorrco Pumps in its plants. Evidence of this progressive Company's confidence in Dorr Equipment.

What about your problems of wet material handling or treatment? Solve them and save money by using Modern Dorr Machines and Methods. Your material may not be similar to lead or zinc, but our experience embraces operations of all sorts, covering such widely differing materials as gold and clay, diamonds and sewage. May we help you?

Bulletin 7071 describes Dorr Equipment and services. Our nearest office will gladly send you a copy.

DENVER, COLO. 1009 17th Street
CHICAGO, ILL. 333 North Michigan Avenue
LOS ANGELES, CAL. 108 West 6th Street
WILKES BARRE, PA. Miners Bank Building
JOPLIN, MO. 319 Joplin National Bank Building
ATLANTA, GA. 1503 Candler Building

THE DORR COMPANY
ENGINEERS
247 PARK AVENUE NEW YORK CITY

INVESTIGATION TESTS DESIGN EQUIPMENT

MELBOURNE, AUSTRALIA
Crossle & Duff Pty., Ltd., 360 Collins Street

TOKYO, JAPAN
Andrews & George Co., Inc., Central P. O. Box F-23

TORONTO, ONT. 330 Bay St.
LONDON
The Dorr Company, Ltd. Abford House, Wilton Rd., S. W. 1
BERLIN
Dorr Gesellschaft m. b. H. Kielganstr, 1 W. 62
PARIS
Societe Dorr et Cie 26 Rue de la Pepiniere
JOHANNESBURG, S. A.
E. L. Bateman Locarno House.

The Eagle Picher Lead Company and I-R Equipment

"Jackhamer" Drills are used for breaking up boulders, for drilling in the drifts and stopes, and for countless other jobs.

The long list of I-R machines in service at the various mines of the Eagle Picher Lead Company is due to *repeat orders* which have gradually increased with the expansion of the Company since its beginning in 1915.

We congratulate the Eagle Picher Company, one of the four largest operating companies in the Tri-State district, and we are proud that I-R machines contributed in some measure to their success.

INGERSOLL-RAND CO., 11 Broadway, New York

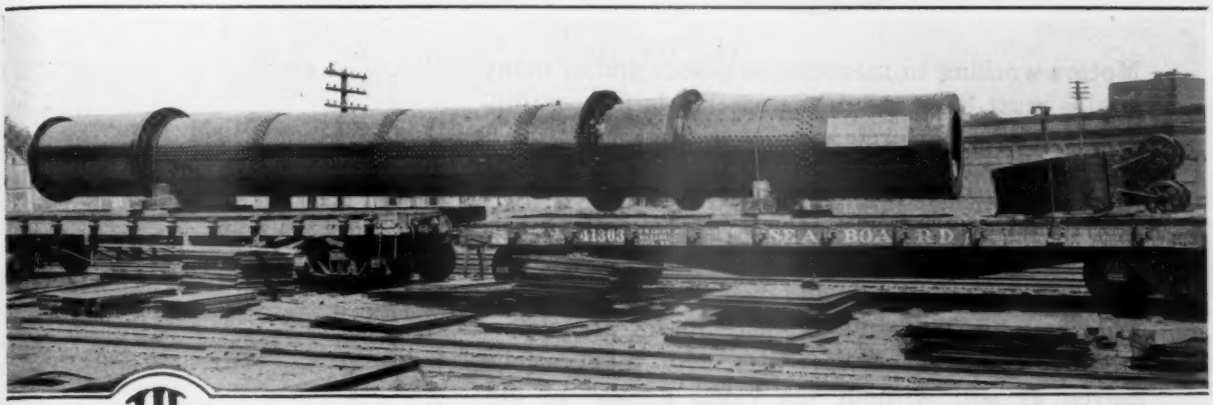
Drifter drills mounted on columns are used for driving the headings and crosscuts, and for stoping where deep holes can be drilled.

The tripod mounting permits drilling lifter or toe holes close to the floor. This method proves effective in loosening material at the loading face, commonly known as taking up stope.

60-RDM

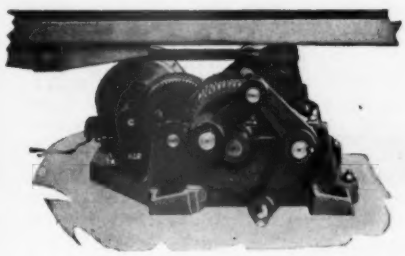
Ingersoll-Rand

VULCAN



at EAGLE-PICHER

This kiln is used at Eagle-Picher for the continuous alteration of barytes. It replaces several batch machines, previously used, thus simplifying the process and making it more efficient and economical. Rotary kilns are subject to trying conditions. The value of these machines is determined by their design, material and workmanship. Simplicity and dependability are essential to their satisfactory service. Vulcan has made all parts large, strong and easy of access.



Let us send you details on Vulcan Shaking Chute Conveyor for handling stone, gravel, sand, clinker, etc.

Other VULCAN products include complete lines of locomotives, hoists, shaking conveyors, sheaves, etc.

VULCAN IRON WORKS
WILKES-BARRE, PA.

Send for booklets describing this or other mining equipment.

VULCAN of WILKES-BARRE, PA.
MINING EQUIPMENT

Westinghouse Room Hoist Motors

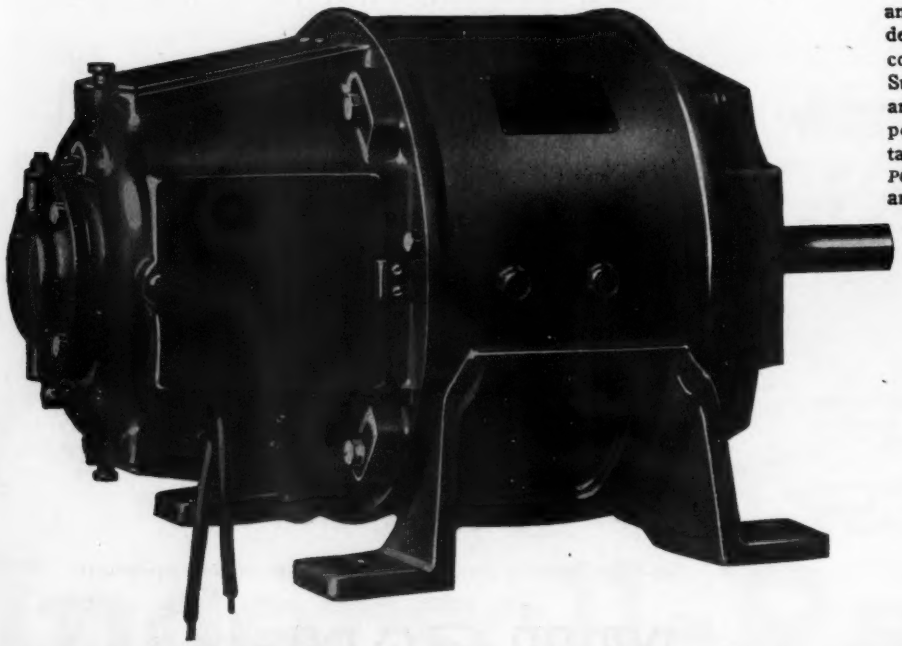
TIMKEN BEARING EQUIPPED

Motors working in inaccessible places and at many angles must have *the* prime essentials for continuous, unfailing performance.

They must be able to go for months without renewed lubrication—for years without perceptible wear. Room hoist motors are dragged from place to place—sometimes rolled over and over through the mine. That is why Timken-equipped motors are super-reliable in severe service—also why they can be moved at will without the usual danger of oil-soaking.

Not merely effective friction-elimination but full radial-thrust capacity makes Timkens the logical bearings for motors.

THE TIMKEN ROLLER BEARING COMPANY
C A N T O N , O H I O



Timken mountings are simple and compact, simplifying both design and construction in completely enclosed motors. Supreme endurance in fully anti-friction motors is made possible only by Timken tapered construction, Timken *POSITIVELY ALIGNED ROLLS* and Timken steel.

TIMKEN *Tapered Roller* **BEARINGS**

The MINING CONGRESS JOURNAL

**A Monthly Magazine—The Spokesman For The Mining Industry—
Published By The American Mining Congress**

VOLUME 15 NOVEMBER, 1929 No. 11

Editorials

Lead in Industry

THE lineage of lead dates back to the dawn of civilization, and considerable trade in this metal was carried on centuries before the Christian era. It is a potent factor in industry today. It enters into world commerce in all stages of refinement as crude ore, concentrates, base bullion, refined pig-lead, and in a variety of manufactures. The United States produces and consumes approximately 35 percent of the world's total production.

Such an important adjunct to civilization, commerce and national wealth should have the wholehearted support of the country in its efforts to survive foreign competition and to surmount its intricate production problems. The information contained in the Lead and Zinc Section of this issue tells a story of a great industry, and how it has recognized, met and conquered many of the problems that have beset it, and what it has to offer today to our industrial, economic and luxury requirements.

Zinc in Industry

IT IS a far cry from house paint to face powder, but zinc makes the grade. It is one of the three important non-ferrous metals. Its adaptability is remarkable. It not only paints houses and decorates faces, but it protects wire and sheet metal, adding tremendously to the safety and durability of materials entering into gigantic building and construction projects.

But in spite of its adaptability, its resourcefulness, its necessity as a metal, the industry is faced with the great every-day problems so prevalent in industry today—overproduction. Realizing its situation, the industry has organized a "Research and Market Broadening Plan," which will make market surveys, conduct technical research, advertise the usefulness of zinc, and in many forms broaden the market for this mineral. Like lead, zinc is subject to keen and growing competition from foreign production, and requires a protective tariff. It is unquestionably on its way toward solving its problems.

Tariff Bill Prospects

WITH the special session approaching its end, there has been serious doubt as to whether the tariff bill will pass. If it fails of passage, tariff revision undoubtedly will become the major business of the regular session. The dissatisfaction of important groups, such as those representing the agricultural states, has resulted in a coalition of Democrats and so-called insurgent Republicans with a combined vote that has demonstrated the ability of the coalition to rewrite the administrative provisions of the bill. If this coalition can be kept intact during the consideration of the rate schedules, there would seem to be little chance for the bill's passage.

However, there are indications that the Republicans supporting the Finance Committee's bill will agree to enough changes in which individual members of the coalition are interested to cause a different division on the rate schedules than was effective during the consideration of the administrative provisions. That this is entirely probable is evidenced by the defeat of the Thomas resolution which proposed to limit the rate changes in the bill to items in which agriculture alone is primarily interested, and also by the adoption of certain rate changes that have been recommended by the Finance Committee and substituted for committee amendments proposed in the report of the Financial Committee.

The uncertainties that have prevailed during the last two months undoubtedly have been injurious to business. The country unquestionably will suffer a considerable economic loss and possibly business depression unless the bill is acted upon promptly and the uncertainties are eliminated. The issues created by the action of the Senate in striking out the flexible provisions and tacking on the debenture amendment do not present insurmountable obstacles to the passage of the bill, as these questions can be dealt with by the Conference Committee.

It is believed that the Senators generally are cognizant of the unfavorable conditions that may result from prolonging the tariff debate and forcing the proposed legislation into the regular session. Therefore, final action on the bill may reasonably be expected before the 20th of November and prompt action by the Conference Committee is certain to follow. Since the completion of the bill is something that should be done without delay, it may be assumed that the Senate will function to accomplish that end.

Creating an Artificial Sympathy

IN A RECENT issue we commented upon an article by a well-known writer which carried a vast amount of misinformation concerning the mining industry. In fact we are being charitable when we call it "misinformation." It was little short of hallucination, and could only be tolerated because of the frankly imaginary tendency apparent in writings of men who make their living by appealing to the imagination of the public.

And now comes a new book, "The Gate of a Strange Field," or "The Tragedy of the Mines." This is a product from the pen of a British author, who has "spent most of his life in the mines." In a current review it is pointed out that the book is somber but that

V 15 11 1 NOV 29 XU

the "soberness is the soberness of darkness, foul air, human passions that wreck, and the compelling force of the big, dark pit which sucks them at last into the black heart of an earth that has been cruel to them."

Granting full poetic license to these authors, it is high time that the mining industry—especially the coal mining industry—defend itself. Just what are mining conditions? Good and bad, of course, as in any industry, but preponderently good. Otherwise why will men both in the United States and in Europe fight for the chance to work in the mines? Why do we have thousands of men in the coal fields who refuse any other method of livelihood? Surely not because they are slaves, nor because they enjoy the horrible punishment these writers say they suffer.

In no other industry, unless possibly it be the steel industry, has more been done to advance safety, health and comfort of the workman. Working in a uniform temperature, shielded from heat and cold, mechanically provided with an abundance of pure air from the outside, in most states enjoying an eight-hour day, it is no wonder that the mining industry is overmanned, and a constant surplus of men, ready to increase production.

Mining offers lucrative work under conditions that are above the average in comparative industry.

Pay Him Higher Wages

THERE is a certain group that continually chant the song of higher wages, shorter working hours, and the pampering of our laboring class. Many are the reasons advanced for this pampering. But usually they begin and end in a sentimental theory that the downtrodden worker must be uplifted, and their origin is usually in the minds of those who sentimentalize rather than practice.

Frequent advice is given to industry to pay the worker "higher wages; give him more leisure; institute the five-day week; surround him with every safeguard; offer him every possible luxury" because, after all, he is industry's "best customer."

We agree with these advisors only to the extent that industry shall pay the highest possible wage commensurate with good business. And good business means that the industry that pays the worker shall have a surplus to create more industry to employ more labor.

The laborer in the final analysis is his own best customer. He buys 86 percent of what he produces, and when his wages are prohibitive, he defeats his own purpose. Would our well-meaning advisors advocate a standard wage, leveling the laborers' earning power? Why not pay all labor $20 per day, work him four hours, give him free medical, social and recreational features? Where would the vicious circle end? Certainly not in the laboring man's favor.

Benefitting Humanity

PATERNALISM is a hateful word to every independent thinker. The average American citizen wants to be entirely independent and therefore aims to be self-supporting and to render full consideration for the pay which he may receive. In our scheme of civilization the reward of riches seems to come to many who have not earned it. Newspaper headlines frequently indicate that there has been a loss or a gain of ten to fifteen million dollars upon stock exchange transactions for a single day. The property upon which the securities were based remains the same in value whether there be a loss or gain in the stock transaction. It is true that these transactions do have an ultimate effect upon the prosperity of the country, an effect much in excess of the actual part played in our industrial life. The honest wage earner renders a full service for the wages secured. That wage should be such that during his working years he may be able to live in comfort, educate his family and provide for his unproductive later years. A wage which does not permit this to the prudent, economical man, is an unjust wage. Various efforts are continually in progress by people more or less misguided, who are anxious to alleviate the conditions of those who are not prudent, and who spend each day their full earnings without effort to provide for the future. Among their efforts in this behalf are compensation legislation and industrial group insurance.

Mr. Matthew Woll, vice president of the American Federation of Labor, in a recent article in *Nation's Business* calls attention to the effect that such legislation, intended for social purposes in industry, which he said "is being used for contrary purposes. We have a growing tendency in big industry to refuse to hire men of 40 and over, with increasing difficulties for men of large families to find work. Rates for such insurance are based on the average age of the men employed and the rates are computed annually. Rates are kept down when average ages are kept down—and so the older men have to go. What began as a beneficial thing becomes a destroyer of home and happiness, a bringer of insecurity instead of security. Also, there are pension systems that are perverted from the original purpose bringing sad results instead of encouraging results."

However much we may condemn the refusal of industrial organizations to employ men who are likely to become a continuing charge upon their employer, it would seem that natural economic laws force discrimination against the older man. Under proper conditions the man from 40 to 60 years of age should be altogether more valuable to the employer than the younger man because of his larger experience, better knowledge and more stable character. Whether these efforts on the part of reformers result in advantage to those for whose benefit they are intended or whether such efforts are entirely misguided and only serve to bring penalty, is a question which calls for serious consideration. A distinguished woman from a western state who had been active in efforts for the betterment of conditions and had advocated various reforms which have been put into effect, said a few years ago that if she lived long enough to undo many of the reforms in public affairs which she had helped to inaugurate, she would die happy.

This discussion is not intended as an expression of opinion either for or against the efforts of many public-spirited citizens who are anxious to benefit humanity, but only as a warning that any reform which violates fundamental economic laws should be scrutinized with great care as in the end it may work more disadvantage than benefit.

The Lobby Investigation

DURING recent years there has been an increasing tendency on the part of the United States Senate to investigate the various agencies which represent the industries of the country in Washington, and the public is being led to believe that the Senate is a superhuman body which, having been once created, has no further obligation to the people of the states they represent. Frequent bills have been prepared looking to the registration, as lobbyists, of all men who come to Washington in behalf of the industries which they represent, in order that they may present to the various Senators proper information concerning the needs of these several industries. The widening gulf which is being created between the people and their rep-

resentatives is filled with dangers to representative government. There are two phases of this growing tendency to which Senators might give careful consideration:

First, the slander which is involved in the suggestion that Senators are corruptible and therefore must be protected against every outside contact which may be, or be suspected of being, anxious to exercise an improper influence. It is a most unfortunate situation when public confidence in our Government and its officials is broken down. Suspicion of all governmental agencies is altogether too prevalent without having it enhanced and cultivated by the Senate itself. It is hard to understand the psychology more or less prevalent, which suspects every man in public life, no matter how clean a reputation he may have had as a business man. Second: If such suspicion prevails in the United States Senate as to men of distinguished business success, who are asked to give up enormous earnings in their business in order to serve the public, what can be expected of the average citizen who can only keep partially posted in public affairs and who hears suspicions and incriminations lodged against public officials, other than that he will believe all of the statements which are made and thus assume that all public men become corrupt by virtue of their elections. This is a most unfortunate condition of affairs and one in which the Senate should join with all lovers of Government to break down. The halfway position between those who have absolute faith in the integrity of our Government as a whole and the communist, who is an enemy to all Government, is a dangerous position. Let it be assumed that public officials in all but exceptional cases, are honorable men, striving to perform their public duty to the best of their ability.

Facts and Votes

WHILE granting the highest integrity of purpose to the Senate as a whole, its members, in order that they may meet their entire responsibility, must be informed as to the conditions and needs of the business of their different industrial and business centers. It is not possible for any one man to know the details of all these various lines of business when he is called upon to vote on measures which are vital to these various industries. Shall he vote blindly, or shall he have the assistance of the representatives of these various industries in securing the facts without which no intelligent vote can be cast? Why appoint committees to represent the various activities of legislation; why do these committees hold hearings except to gain the information which must be brought to them; and why, when these industries are requested for proper presentation of their views of industrial conditions shall these men be characterized as lobbyists and discredited before the public? The Senate, entirely within its rights, may inquire who a witness represents, and his position in the industry, and all of the facts which go to show the integrity of the witness, as a means of information from which they may infer the motives which inspire the statements made. But if the Senate shall not make the contact between itself and the industries of the country, it will shut the door to the information upon which intelligent action must be based.

Blue Sky Laws and Mine Development

MINERAL development in the United States has established a record for progress which far surpasses that of any other country. And this progress will continue as long as the Government recognizes the right of all individuals to devote in the pursuits of their choice, their time, talents, initiative and capital to research, discovery and development of new ideas, mineral deposits, mechanical devices, methods of communication and transportation, and principles of industrial expansion.

The raising of development funds is one of the difficult problems of the mining industry. When any new development is undertaken, it is, in many instances, a speculative venture. Blue sky laws can be made so restrictive as to prevent such speculation; and, when so designed, are destructive to the mining industry, since its very foundation and continuation depends upon new mineral discoveries and the development of new mines from mere prospects.

Infant mining projects must have capital with which to develop their resources and prove their commercial value. The same was true in the radio, automotive, and aeronautics industries, and would still be true if these industries were not financially self-sustaining. The mining industry has to be renewed and kept alive by new discoveries. And usually the owner of a likely prospect is not willing to turn it over for a small consideration to an established company for development; hence he turns to the public for necessary funds. This, he should always have the right to do.

While the public should be protected against the fakir, and against fraudulent operations of all kinds, the mine prospector and the owner of promising prospects should be permitted to seek and secure the capital of persons willing to join in any legitimate mining venture. Such undertakings should not be restricted or hampered by Blue Sky legislation. In the past they have been the foundation of the mining industry. In the future they will serve to replenish the mineral reserves of the nation as old mines are worked out and abandoned.

When is a Benefit Not a Benefit?

ALL OF those who seek local public improvements are prone to cast about for some agency to which they can appeal for outside assistance—whether the improvement be a Federal public building partly needed for public purposes, and serving an actually important local purpose, or gratification of local pride; or whether it be the construction of a dam or irrigation works, improvement of rivers and harbors, or various appeals to the Federal Government for aid in the development of particular communities. Some of these appeals are justly made, while many of them work in the end to the disadvantage of the community receiving the aid. This disadvantage may be so hidden that for generations it does not manifest itself. One fact must be recognized throughout all of these transactions—the locality receiving the benefit must in the end pay the bill. It would be well for the public if a clearer line of demarkation could be drawn between those expenditures which are of general benefit and therefore should be borne by the larger community, and those which are of local benefit and therefore should be paid for by the community receiving that benefit.

Per Capita Output in Industry

THE old idea that used to prevail among wage earners generally that mechanization of industry would mean less employment has been exploded by the record of the manufacturing industries in the United States.

The per capita output per worker in the value of goods produced this year is the greatest ever recorded, according to a report on business conditions in this country issued by the Chatham Phenix National Bank and Trust Company of New York.

In the outline of business prepared for this banking house, it is stated that "the average wage-earner in an industrial plant will this year turn out products valued at approximately $7,381, exceeding the output for a worker of any other country in the world.

"Payroll total in the manufacturing industry also shows an increase amounting to 8.4 percent as compared with last year, while per capita earnings of employes are approximately 3 percent higher. Both the individual wage earner and workers in the mass are thus seen as reaping the benefit of increased production in the form of higher wages and more abundant jobs."

The agricultural industry is now turning to mechanical equipment and increased output per man as one solution of the shortage-of-labor problem in agriculture. The metal-mining industry already is largely mechanized, and the coal industry is rapidly developing plans and machinery for mechanization.

Thus, instead of unemployment and men being displaced by machines, the level of employment in the nation's industries is steadily increasing, working conditions are better, wages are higher, and mass production has proved a boon to the nation's business.

Every labor saving device, every new machine that has cheapened production, has brought the laboring man increased comfort, increased leisure, and increased financial reward.

Industry has passed from the hands of the privileged few, into the hands of the many. Today an army of employe-owners marches down the aisles of mill and factory, and operates the power plant, and the railroad over which it rides.

Mine Accidents and Fatalities

IT IS pleasing to note from announcements of the Bureau of Mines that the injury and fatality rates in metal-mining operations are declining year by year. In 1928 fatal mishaps in metal mines were reduced by 19 percent; and the injury rate declined 7 percent as compared with figures for the preceding year. This record indicates that in all branches of the metal-mining industry, the hazards of employment are being reduced, and the continued improvement shows the efficiency of safety methods and the value of safety instruction and rules.

The Bureau of Mines has been an important factor in the safety movement and in the work of accident prevention. Through the studies and efforts of the Bureau, many of the causes of accidents have been eliminated. The Bureau's work in accident prevention and in helping to make possible the reduction of losses from accidents that can not be avoided is noteworthy and highly commendable.

The cooperation of employers and workers also has contributed to the results achieved in accident prevention by removal or reduction of hazards, and the faithful observance of rules necessary to the maintenance of conditions that promote safety. It is this splendid cooperative effort on the part of the Bureau of Mines, mine employers and mine workers that will continue to result in declining injury and fatality rates in the mining industry.

A Boomerang Principle

ELBERT HUBBARD once said that no purchase is satisfactory unless both buyer and seller make money. When labor attempts to give capital a black eye, labor receives in return a more severe injury.

Under existing conditions in the United States, a higher percentage of luxury-purchases is being made than ever before. The laborers of today buy radios, automobiles, furniture, player-pianos and houses, beyond their wildest dreams a generation ago. In America, as contrasted to every other nation on earth, thousands of workmen own their own homes. Nowhere else do thousands of laborers and their families attend the movies, fill the baseball parks, and tour across a half dozen states.

Yet in the face of this incomparable situation there are those who would recognize the Soviet Government principle of "giving Capital a black eye."

The wages paid to labor for the manufacture of the articles which labor buys, the cost of raw material production, all this flow of currency, like the electric current which gives us light and power, must flow in an unvarying and continuous stream if labor is to continue absorption of its own production, and continue to mount, with ever-increasing power to the pinnacles of independence and ascending standard of living.

Short Cuts in Government Procedure

COMMISSIONER LEWIS, Chairman of the Interstate Commerce Commission, stated recently to an audience of business men in Indianapolis that the Commission has experimented in a limited way with the substitution of a round-table conference for the formal procedure involving extensive hearings and formal examination of witnesses. Chairman Lewis indicated that the Commission is about ready to make use of the conference plan in the settlement of important valuation questions as well as in a wide variety of other questions that come before it.

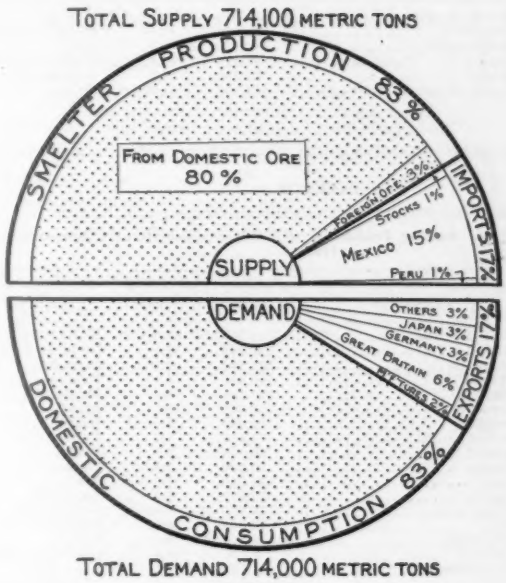
In this connection it will be remembered that the Bureau of Internal Revenue, which has handled an inconceivable volume of business since 1917, resorted to the use of the conference system of dealing with audit and valuation questions under the Income Tax Law, instead of adopting a formal procedure which would have resulted in such a congestion of unsettled controversies and claims as to completely paralyze the income tax collection machinery. The Bureau of Internal Revenue has had to value as of 1913 not only all of the railroads of the United States, but also all of the mines, oil and gas wells, manufacturing plants and office buildings, ships, patents, formulae and almost every conceivable item of property of value existing at March 1, 1913. This work had to be done in order to determine allowances for wear and tear, exhaustion, obsolescence, depreciation, depletion, loss or gain from sales and losses from fire and storms, etc.

It is pleasing to note that the Interstate Commerce Commission is seeking to reduce the detailed formality of its procedure, and to find "short-cuts through the mazes of hearings, arguments, briefs and reply briefs attendant upon the work of an executive, administrative and quasi-judicial body." If this commission decides to adopt a conference plan for simplifying its procedure, perhaps other similar Government agencies will find an incentive for undertaking to simplify and improve their methods of procedure. Certainly the give-and-take settlements of reasonable men conferring in an atmosphere of amity is better than compromises dictated in an atmosphere of mutual animosity.

Flow of LEAD into WORLD TRADE in 1928

By ELMER W. PEHRSON*

From 1801 to 1927 the world produced fifty-three million, one hundred thousand tons of lead—Sources of supply, points of consumption and details of the flow of lead between the various countries outlined



Summary of the primary lead industry of the United States, 1928

LEAD has served man usefully since the dawn of history, and a considerable trade in lead was carried on centuries before the Christian era. The nature of its occurrence, the ease with which it is smelted from ores, and its unique properties permitting easy casting and fabrication undoubtedly contributed to the early establishment of lead as a valued commodity. In Asia it is believed that lead mines were worked by the ancient Chinese, and it is said that these people used lead coins as early as 2000 B. C. The people of many of the early Mediterranean civilizations used lead widely. It was produced at Laurium by the Greeks. The Phoenicians and Carthaginians worked mines in Spain from which lead was carried to many parts of their extensive empires. The early Britons produced lead which they exchanged for products brought to them by traders from Asia Minor. The Roman Empire at its height derived lead from many areas in Europe which are still active.

After the fall of Rome, however, there appears to have been a marked recession in European production, which continued until interest in mineral wealth was aroused by the stimulation of industry and the arts occasioned by the Rennaissance and the discovery of America.

At the beginning of the nineteenth century the annual world production of lead was about 22,000[1] metric tons. World trade was largely confined to Europe, and Great Britain and Spain were the principal sources of supply. A small quantity of lead was shipped to the United States. Since 1800 world production has increased at a remarkable rate and the world trade in lead has become world-wide.

In the 127 years from 1801 to 1927, inclusive, the world produced a total of 53,100,000 tons of lead, as shown by a study recently completed in the Bureau of Mines.[2] Since this largely exceeds a production of 37,000,000 tons of copper[3] and 34,000,000 tons of zinc[4] during the same period, it might well be claimed that lead has been the most useful of all the nonferrous metals.

In 1928 the world production of lead was 1,693,000 tons, and over 1,000,000 tons of various lead products were exchanged by the nations of the world. In the text which follows, an attempt will be made to show the sources of supply, points of consumption, and some details of the flow of lead between the various countries.

Due to a lack of data and to a lack of uniformity in available data, the writer has resorted to some estimation in order to present a summary of the world situation. Official reports of many countries which cover import and export statistics have been consulted and used where possible. The compilations of the American Bureau of Metal Statistics have been used extensively, as well as many American and foreign technical publications. The statistics on world production have been compiled from official Government records by Miss L. M. Jones, of the Bureau of Mines.

Lead enters into world commerce in all stages of refinement—as crude ore, concentrates, base bullion, refined pig lead, and in a variety of manufactures. A comprehensive presentation of world trade would involve a segregation of the flow of each of these products. Such a study, however, is beyond the scope of this paper and its preparation would be difficult with present inadequate world statistics. This study is therefore confined to world flow of pig lead, including both base bullion and refined lead, and of lead ore and concentrates.

The quantity of lead and lead products entering world trade in 1928 is estimated as follows:

	Metric tons
Pig lead and base bullion	875,000
Lead ore and concentrates	240,000
Lead pigments	60,000
Lead manufactures (sheets, pipe, etc.)	50,000

WORLD TRADE IN PIG LEAD

The production and consumption of lead in 1928 is contrasted by continents in Table I.

* Mining engineer, Common Metals Division, U. S. Bureau of Mines.

Published by permission of the Director, U. S. Bureau of Mines (not subject to copyright).

[1] The metric ton is used throughout this paper.

[2] Smith, L. A.: Summarized Data of Lead Production: U. S. Bureau of Mines, Economic Paper 5 (in course of printing).

[3] Julihn, C. E.: Summarized Data of Copper Production: U. S. Bureau of Mines, Economic Paper 1.

[4] Pehrson, E. W.: Summarized Data of Zinc Production: U. S. Bureau of Mines, Economic Paper 2.

TABLE I

Production and Consumption of Lead in 1928 (By Continents)

PRODUCTION			CONSUMPTION		
Continent	Metric tons	Percentage of total	Continent	Metric tons	Percentage of total
North America	951,800	56.2	Europe	873,300	53.4
Europe	434,500	25.7	North America	620,500	38.0
Australasia	165,800	9.8	Asia	82,600	5.0
Asia	91,400	5.4	South America	28,000	1.7
Africa	27,000	1.6	Australasia	20,000	1.2
South America	22,500	1.3	Africa	12,000	0.7
Total	1,693,000	100.0	Total	1,636,400	100.0

TABLE II

World Smelter Production of Lead by Countries, 1928

Countries	Metric tons	Percentage of total
United States	592,200	35.0
Mexico	223,000	13.1
Australia	165,800	9.8
Canada	136,600	8.1
Spain	110,100	6.5
Germany	110,000	6.5
Belgium	92,000	5.4
British India	79,600	4.7
Poland	36,400	2.2
France	22,900	1.4
Italy	21,200	1.3
Tunisia	17,600	1.0
Yugoslavia	13,900	0.8
Peru	13,500	0.8
Argentina	9,000	0.5
Austria	8,100	0.5
All others	41,100	2.4
Total	1,693,000	100.0

TABLE III

Approximate World Consumption of Lead by Countries, 1928

Countries	Metric tons	Percentage of total
United States	596,500	36.5
Great Britain	242,500	14.9
Germany	240,000	14.7
France	104,000	6.4
Belgium	71,000	4.3
Japan	66,100	4.0
Italy	48,200	2.9
Russia	34,000	2.1
Poland	24,200	1.5
Canada	21,000	1.3
Spain	19,600	1.2
Australia	18,700	1.1
Netherlands	18,000	1.1
Argentina	17,000	1.0
Austria	15,500	0.9
Czechoslovakia	15,200	0.9
All others	84,900	5.2
Total	1,636,400	100.0

TABLE IV

EXPORTING COUNTRIES	Net export, metric tons	IMPORTING COUNTRIES	Net import, metric tons
Mexico	220,000	Great Britain	236,000
Australia	147,100	Germany	130,000
Canada	115,600	France	81,000
Spain	90,500	Japan	62,100
British India	73,800	Russia	32,000
Belgium	21,000	Italy	27,000
Tunisia	17,600	Netherlands	18,000
Poland	12,200	Czechoslovakia	12,200
Peru	11,800	Argentina	8,000
Yugoslavia	8,600	Austria	7,400

Europe does not produce sufficient lead to supply its requirements and imports large quantities from North America, Australasia, and Asia. North America, on the other hand, has a substantial surplus which is exported chiefly to Europe and Asia. Australasia exports its surplus to Europe. Asia, strangely enough, consumes lead imported from North America and exports its own product to Europe. This is due to the great distance between the producing and consuming centers and inadequate continental transportation. South America and Africa are as yet minor factors in the world situation, but a more important role is indicated for the future.

Before considering the detailed flow of lead a contrast of the production and consumption of the various countries may be of interest.

Table II shows the world production of lead in 1928 by countries, in order of importance. The figures given are based on the quantity of lead produced from the smelting of lead ores regardless of whether the ore was of domestic or foreign origin. Production of refined lead from foreign base bullion is not included in the production of the United States, but may be included in the production of some of the European countries for which data permitting a separation are lacking. The production of the United States as shown does not include the pig lead produced from scrap materials, whereas the figures for some of the European countries do include lead so produced.

Estimates of consumption of lead in the various countries are, with few exceptions, difficult to make, owing to a lack of pertinent data. In general, consumption is figured on the basis of production plus imports minus exports. Only in the United States and Great Britain are there available data on the variation in stocks, and even these are incomplete. Estimates of consumption in some of the European countries are confused by duplication in production reports due to the fact that often one country refines the base bullion of another. The figures given for the United States in Table III include only the consumption of primary lead. Figures for some of the other countries include secondary lead.

The United States is an outstanding factor in the world's lead industry, producing and consuming about 35 percent of the world total. The British Empire produces 23 percent of the world's supply of lead and consumes 18 percent. The production is confined to the outlying dominions while the mother country is by far the principal consumer. Germany produces 6.5 percent but consumes nearly 15 percent. France and Tunisia produce 2.5 percent, while France alone consumes 6.4 percent. The production of pig lead in Belgium exceeds the consumption, but practically all of the lead is derived from imported ores. Japan, Italy, and Russia are largely dependent on foreign sources of pig lead.

In considering world trade it is customary to classify countries as either exporting or importing. In Table IV the most important countries are so classified in 1928.

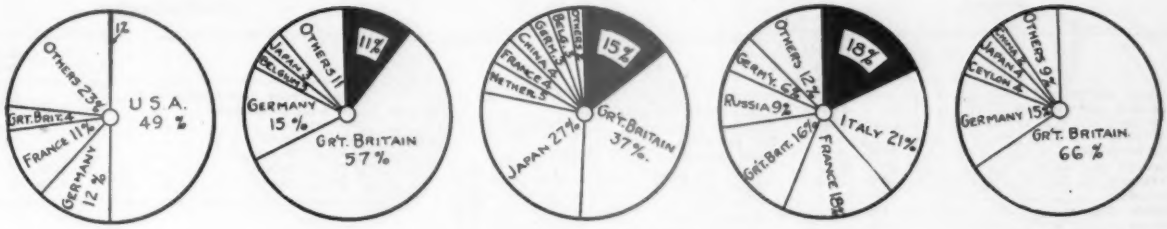
The major currents of lead in 1928 as listed below amounted to 70 percent of the total world trade:

	Metric tons
Australia to Europe (mostly Gt. Britain)	124,000
Mexico to United States	109,000
Spain to other Europe	80,000
United States to Europe	79,000
Canada to Europe	72,000
British India to Europe	60,000
Canada and United States to Japan	56,000
Tunisia to France	15,400

United States

The United States occupies a unique position in that it is both an important importer and exporter of pig lead. In recent years the smelter production has about equaled the apparent consumption, so that in general it may be said that the United States is self-sufficient with respect to pig lead. The large foreign trade in this commodity is due to the importation of foreign base bullion which is refined in bonded smelters and subsequently reexported as refined pig lead.

The primary lead industry of the United States in 1928 may be summarized as follows:



MEXICO
Production,
223,000 tons

AUSTRALIA
Production,
165,800 tons

CANADA
Production,
136,600 tons

SPAIN
Production,
110,100 tons

BRITISH INDIA
Production,
79,600 tons

100 percent represents total production of country.
Black segments represent portion consumed at home.
White segments represent destination of export surplus.

FLOW OF LEAD FROM THE IMPORTANT EXPORTING COUNTRIES IN 1928

SUPPLY

	Metric tons
Smelter production	592,000
From domestic ores	96%
From foreign ores	4%
Withdrawals from warehouse stocks	4,800
Imports of refined lead and base bullion	117,100
From Mexico	93%
Peru	7%
Total supply	714,100

DEMAND

	Metric Tons
Domestic consumption	596,500
Exports of manufactured foreign lead	12,000
Exports of pig lead	105,500
Destination:	
Great Britain	37%
Germany	20%
Japan	18%
Sweden	5%
Netherlands	4%
France	4%
Denmark	3%
Brazil	2%
China	2%
Others	5%
Total demand	714,000

Flow of Pig Lead from the Principal Exporting Countries, 1928

Mexico

Official data on the flow of Mexican pig lead in 1928 are not available. The following summary of exports is based on the import data published by other countries and is only approximately correct:

	Metric tons
Estimated production	223,000
Estimated consumption	3,000
Estimated export surplus	220,000
Destination:	
United States	50%
Germany	12%
France	11%
Great Britain	4%
Netherlands	1%
Belgium	1%
Others	21%

In 1928 the United States imported 109,347 tons of pig lead from Mexico, of which 108,801 tons was base bullion. This bullion was refined in the United States, and it is estimated that approximately 80,000 tons of the refined product was reexported in 1928. The destination of this product was approximately as follows:

	Percent
To Great Britain	30
To Japan	20
To Germany	20
To Netherlands	5
To Sweden	5
To France	5
To China	2
To Brazil	2
To Argentina	1
To Belgium	1
Others	9

Australia

	Metric tons
Pig lead production	165,800
Estimated consumption	18,700
Net export	147,100
Destination:	
Great Britain	65%
Germany	17%
Belgium	3%
Japan	3%
New Zealand	1%
China	1%
Others	10%

Canada

	Metric tons
Pig lead production	136,600
Estimated consumption	21,000
Net export	115,600
Total export	115,900
Destination:	
Great Britain	43%
Japan	32%
Netherlands	6%
France	5%
China	5%
Germany	4%
Belgium	3%
Others	2%

Spain

	Metric tons
Pig lead production	110,100
Estimated consumption	19,600
Net export	90,500
Total export	91,000

Official data on the destination of the 1928 exports are not available. The following distribution is based on imports reported by other countries and is only approximately correct:

	Percent
Italy	26
France	22
Great Britain	19
Russia	11
Germany	7
Belgium	1
Netherlands	1
Others	13

British India (Burma)

	Metric tons
Pig lead production	79,600
Actual export	73,800
Destination:	
Great Britain	66%
Germany	15%
Ceylon	4%
Japan	4%
China	2%
Others	9%

Belgium

The imports of lead into Belgium are believed to consist largely of argentiferous lead and scrap which is included in the production figure given below. The imports are therefore disregarded in figuring consumption:

	Metric tons
Pig lead production	92,000
Estimated consumption	71,000
Net export	21,000
Destination:	
France	32%
Germany	28%
Netherlands	23%
Great Britain	3%
Rumania	2%
Others	12%

Tunisia

	Metric tons
Pig lead production	17,600
Net export (estimated)	17,600
Distribution (estimated):	
France	93%
Italy	5%
Algeria	2%

Poland

	Metric tons
Pig lead production	36,400
Estimated consumption	24,200
Net export	12,200
Destination:	
Czechoslovakia	38%
Austria	28%
Germany	20%
Hungary	6%
Russia	4%
Others	4%

Peru

	Metric tons
Pig lead production	13,500
Total exports, 1928	11,800
Approximate distribution based on imports to other countries:	
United States	65%
Great Britain	10%
Others	25%

Yugoslavia

	Metric tons
Pig lead production	13,900
Estimated consumption	5,300
Net export	8,600
Total export	8,800
Destination:	
Austria	56%
Hungary	40%
Germany	2%
Czechoslovakia	2%

Flow of Pig Lead Into the Principal Importing Countries in 1928

Great Britain

	Metric tons
Approximate consumption	242,500
Pig lead production	5,600
Net imports	236,000
Total imports	260,000
From Australia	36%
From United States	18%
From Canada	18%
From British India	14%
From Spain	6%
From Mexico	3%
From Belgium	2%
From others	3%

Germany

The estimated consumption of pig lead in Germany as given below is probably high on account of the fact that some base bullion imported for refining is also included in the production figures as refined lead. Data are not available which would permit a more precise separation. The American Bureau of Metal Statistics estimates the consumption of lead in Germany in 1928 at 216,500 metric tons.

	Metric tons
Approximate consumption	240,000
Pig lead production	110,000
Net imports	130,000
Total imports	148,500
From United States	30%
From Mexico	19%
From Australia	17%
From British India	13%
From Belgium	8%
From Spain	5%
From Great Britain	2%
From Canada	2%
From others	4%

France

	Metric tons
Approximate consumption	104,000
Pig lead production	22,900
Net imports	81,000
Total imports	81,600
From Mexico	29%
From Spain	25%
From Tunisia	20%
From Turkey	6%
From Belgium	5%
From United States	5%
From others	10%

Japan

	Metric tons
Approximate consumption	66,100
Pig lead production	4,000
Net imports	62.100
Total imports	62,100
From Canada	47%
From United States	42%
From Australia	6%
From British India	4%
From others	1%

Russia

Official statistics for the year 1928 are not available. The following summary of imports is based on official reports covering the six-month period ending March 31, 1928, and the six-month period ending March 31, 1929:

	Metric tons
Estimated production	2,000
Imports	32,000
Approximate consumption	34,000
Origin of imports:	
From France (probably of Spanish origin)	34%
From Great Britain	21%
From Germany	13%
From United States	9%
From Canada	4%
From India	3%
From Australia	3%
From Austria	2%
From others	11%

Italy

	Metric tons
Approximate consumption	48,200
Pig lead production	21,200
Net imports	27,000
Total imports	27,100
From Spain	85%
From Austria	2%
From Germany	2%
From others	11%

Netherlands

	Metric tons
Approximate consumption	18,000
Pig lead production	0
Net imports	18,000
Total imports	18,200
From Belgium	45%
From United States	20%
From Canada	18%
From Mexico	7%
From Spain	5%
From Germany	2%
From others	3%

Czechoslovakia

	Metric tons
Approximate consumption	15,200
Pig lead production	3,000
Net imports	12,200
Total imports	13,100
From Germany	37%
From Poland	26%
From others	37%

Argentina

	Metric tons
Approximate consumption	17,000
Pig lead production	9,000
Net imports	8,000
Origin of imports based on 1927 figures:	
Spain	48%
Belgium	20%
United States	17%
Great Britain	11%
Others	3%

Austria

	Metric tons
Approximate consumption	15,500
Pig lead production	8,100
Net imports	7,400
Total imports	8,300
Approximate origin:	
Yugoslavia	60%
Poland	40%

World Trade in Lead Ore

Owing to the facility with which lead ore is reduced to metal the smelting operation usually takes place in the country in which the ore is produced. Consequently, only a relatively small part of the world's production of ore enters world trade. In 1928 it is estimated that approximately 240,000 tons of lead ore and concentrates entered world trade. If the recoverable lead content be reckoned at 45 percent, the metallic lead represented by these shipments amounts to 108,000 tons, or about 6 percent of the total world output.

The following table shows the principal lead-ore importing and exporting countries in 1928:

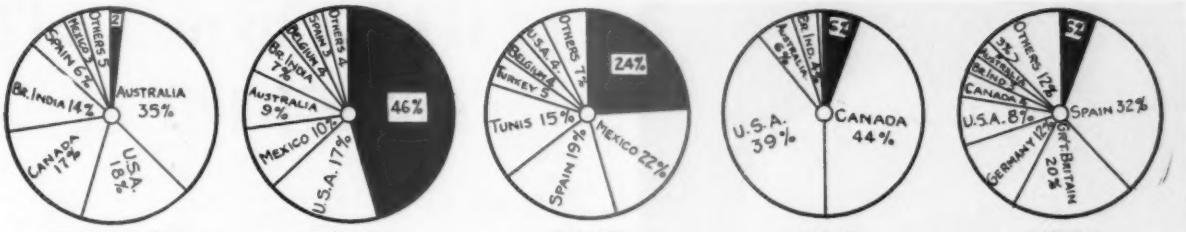
EXPORTING COUNTRIES

	Net exports, metric tons
Mexico	* 65,000
Great Britain	* 20,000
Algeria	18,300
Bolivia	18,000
Italy	17,200
Australia	11,500
Canada	* 11,000
Chile	* 10,000
Peru	7,200

IMPORTING COUNTRIES

	Net imports, metric tons
Belgium	57,200
United States	* 50,000
Germany	31,650
France	19,100
Poland	16,300

* Estimated.



GREAT BRITAIN Consumption, 242,500 tons

GERMANY Consumption, 240,000 tons

FRANCE Consumption, 104,000 tons

JAPAN Consumption, 66,100 tons

RUSSIA Consumption, 34,000 tons

100 percent represents total consumption of country.
Black segment represents portion supplied by domestic smelters.
White segments represent origin of imported lead.

FLOW OF LEAD INTO THE IMPORTANT IMPORTING COUNTRIES IN 1928

The flow of lead ore may be summarized briefly as follows:

Exporting Countries

Mexico is the largest exporter of lead ore in the world. The total ore exports represent about one-eighth of the total mine production. Approximately 85 percent goes to the United States and the balance is shipped to Europe.

Algeria exported 23,900 tons of ore in 1927 and imported 5,600 tons, leaving a net export of 18,300 tons; 82 percent of the total export went to France.

Bolivia.—Fifty percent of the Bolivian exports were shipped to Belgium, 30 percent to Argentina, 15 percent to Great Britain, and the balance to the United States and Germany.

Italy exported a total of 19,200 tons in 1928 and imported 2,000 tons, leaving a net export of 17,200 tons; about 40 percent of the total export went to France, 10 percent to Austria, and the balance to other countries. Italy exported about one-fourth of its total mine output in 1928.

Great Britain.—Data on the imports and exports of lead ore in 1928 are not available. In 1927 about 22,000 tons, or approximately 60 percent of the total mine output, was exported, and about 1,500 tons was imported, leaving a net export of 20,500 tons. This ore was shipped to continental Europe, Belgium being one of the principal consumers.

Australia exported 11,500 tons of ores and concentrates in 1928, 65 percent of which went to Belgium, 20 percent to Great Britain, and 15 percent to Germany. The Australian export represented only about 4 percent of the total mine production.

Canada.—Ninety-six percent of the exports were consigned to the United States and the balance to Belgium. The ore exports represented about 4 percent of the total mine output.

Chile.—Approximately 90 percent of the Chilean exports were imported by Germany and 10 percent by the United States.

Peru exported 7,200 tons of ore in 1928, of which about 30 percent was consigned to the United States. Data on the destination of the remaining 70 percent are not available.

Importing Countries

Belgium is the world's leading importer of lead ores. Practically all of its smelter output is derived from imported materials. In 1928, 58,400 tons of lead ore was imported, of which 1,200 tons was reexported, leaving a net import of 57,200 tons. Of the total imports, Bolivia contributed about 20 percent, Australia and Great Britain about 13 percent each, Germany, Spain, Argentina and South Africa about 4 percent each, and miscellaneous countries 37 percent. In addition, a large quantity of lead-bearing residues from the smelting of imported zinc ores was used in the production of pig lead.

United States.—Sixty-six percent of the imports were supplied by Mexico, 28 percent by Canada, and 6 percent by South American countries. Only 4 percent of the total smelter production of primary lead in 1928 was derived from foreign ores.

Germany imported 48,800 tons of ore in 1928 and exported 17,150 tons, leaving a net import of 31,650 tons. Total imports were derived from Australia 23 percent, Chile 18 percent, Argentina 11 percent, China 8 percent, and miscellaneous countries 40 percent. About 85 percent of the ore exported from Germany went to Polish Silesia, and 15 percent to Belgium.

France imported 32,400 tons of lead ore in 1928 and exported 13,300 tons, leaving a net import of 19,100 tons. Data on the sources of French imports are not published, but from the statistics given by other countries they are estimated as follows: Algeria, 60 percent; Italy, 25 percent; Tunisia, 8 percent; Spain and others, 7 percent.

Poland imported 16,300 tons of ore in 1928, about 85 percent of which came from Germany.

BUREAU OF MINES DIRECTOR AT WORLD ENGINEERING CONGRESS

Scott Turner, Director of the United States Bureau of Mines, sailed from San Francisco, Calif., on October 10, to attend the World Engineering Congress in Tokio, Japan, which will be held from October 29 to November 7. Following the appointment of President Hoover, then Secretary of Commerce, as honorary chairman of the World Engineering Congress for the United States, Mr. Turner was appointed by Mr. Hoover as one of the five Federal engineers who are to represent the United States Government at this Congress.

Mr. Turner also holds a commission to represent the American Committee of the World Power Conference, for which he serves on four sub-committees. He has been named as the official delegate of the Canadian Institute of Mining and Metallurgy and has been designated as the official representative of the University of Michigan and of the Michigan College of Mining and Technology, of which he is a graduate. He has also been listed as a member of the official party representing the American Institute of Mining and Metallurgical Engineers.

The object of the World Engineering Congress is to effect an international exchange of the latest knowledge of the sciences and practices of engineering and to bring together the leaders in research, education and business who are directing the trend of engineering activities, thereby initiating and promoting international cooperation and understanding of engineers of the world. The Congress is to be held under the auspices of the Kogakkai, the engineering society of Japan, and has the patronage of the Imperial Japanese Government.

Mr. Turner plans to leave Tokio several days before the return of the official ship, and by taking a shorter route homeward will arrive in the United States two weeks in advance of the return of the rest of the party; he will thus be at his desk in Washington before the 71th Congress convenes on December 2.

The Importance of Zinc in INDUSTRY

By A. P. COBB *

Zinc an essential element in industry—Its uses run the long road from house paint to face powder—One of the prime necessities of present-day industry, with a future which will unquestionably require greater tonnage

ONE encounters an impression now and then that zinc is a somewhat inferior metal in importance to industry; is not quite in the same class as copper and lead.

A little reflection and a proper analysis of the statistics show how unfounded and misleading this idea is.

In fact, zinc needs no apologist. As one of the three principal nonferrous metals, it may claim substantially equal rank with the other two indispensable elements. It is, in fact, quite remarkable, considering the differences in the qualities of these metals, that they should be produced in such nearly equal amounts as they are.

Properly to envisage this, however, it is necessary to make an adjustment in the statistical reports as usually published. The figures as given in most statements show tons produced in the form of metal. A slight addition must be made to the lead figures, practically none to the copper figures, while the tonnages of zinc must be materially increased to give a true picture of the magnitude of its production.

This is because nearly all of the copper is first produced as metal, only a small amount of lead goes directly from ore to other than metallic forms of finished product, while a large quantity of zinc is converted from ore to zinc oxide for instance—that is, to finished product—without first being made into metal. This latter tonnage of oxide and similar forms of zinc is not reported with the metal in the statistical tables.

However, taking the world output of copper, lead, and zinc for 1928 and making the necessary additions, we find the largest and smallest of the three outputs to differ by only about 8 percent.

The figures are approximately as follows:

Copper	1,885,000 tons
Lead	1,860,000 tons
Zinc	1,736,000 tons

If metals and pigments were sold on the basis of the cubic feet of metal contained, instead of by the ton, the order would be upset and the results by bulk would read:

Zinc	7,785,000 cu. ft.
Copper	6,781,000 cu. ft.
Lead	5,262,000 cu. ft.

Here we have more cubic feet of zinc made than of either lead or copper.

These figures, taken in their broadest sense, seem to indicate that the consumption of each of the three metals is dependent, to some extent, on the consumption of the other two. The increase in the use of one involves a greater use of the others and, while their fields have overlapping margins where they compete with each other, each has its own territory where it reigns supreme, as well as a common territory where each finds its outlet in combination with one or both of the others. In a manner it may be said the interests of zinc, lead, and copper are identical, as they share in the prosperity of the same general field of industry, and they suffer together when adversity overtakes it.

The metal zinc possesses several physical characteristics which render it of unique importance to industry.

It resists corrosion, for one thing, and is, therefore, an excellent protective coating for other metals such as iron and steel. Coupled with this property, it has a low melting temperature, but not too low, and a peculiar ability to attach itself to these (*Continued on page* 845)

* Vice president, The New Jersey Zinc Co.

The Use of LEAD in INDUSTRY

By RALPH M. ROOSEVELT*

PROSPERITY of lead producers closely allied with industries not directly associated with lead—Bright outlook presaged by record automobile production, expanding electrical industries, large consumption by paint business, and new uses which are constantly being developed—Formation of Lead Industries Association points to a new era of cooperation

ALTHOUGH lead is popularly associated in the public mind with bullets and pipe and other articles in which the dull gray color and great weight of the metal is readily distinguished, the prosperity of the lead producing companies is dependent only to a minor extent on those uses. Strange as it may seem, the prosperity of the lead producers is closely allied with industries which are not generally assumed to be associated with lead and with uses of lead in such a form that its identity is so concealed as not to be recognized.

The prosperity of electrical manufacturers is of prime importance to the lead industry. In this respect lead is much like copper. Lead, however, is not used as a conductor of electricity, but, on the contrary, as an ingredient of fuses it may be used to resist the flow of electricity. Three other properties of lead are employed in the electrical industry. One is its pliability, another its corrosion resistance, and the third its ability in certain chemical forms to store electricity. The storage battery business uses, in the form of lead oxides and antimonial lead, roughly a third of the lead produced in the United States. And when to this is coupled the large amount of lead which is used for cable covering —an amount only slightly smaller than that going into storage batteries—one may readily grasp the importance of the electrical industries to lead. With the automobile industry, which is the principal consumer of storage batteries, establishing a new production record this year, and the telephone and electric power companies expanding constantly, it appears that more lead will find its way into these industries this year than ever before.

Years before Kettering discovered the advantages of using storage batteries to start and light automobiles, and before public utility companies found it advisable to bury their cables underground instead of stringing them overhead, the paint industry was the largest single outlet for lead. Lead in various forms is one of the oldest paint pigments and still is the base for the finest paints. Although of late years many newer and less expensive pigments have entered into competition with lead, the lead pigments are successfully meeting this competition due to their superior hiding and protective qualities. For the protection of iron and steel against atmospheric corrosion lead has demonstrated its superiority beyond any shadow of a doubt. This is an important consideration at a time when steel is being used more and more as a material of construction. Recent developments likewise seem to indicate that an entirely new field may be opened for lead in the protection of underground pipe lines. Available statistics apparently show that all of the lead pigments will enjoy a better year in 1929 than they did last year, seasonal depressions thus far this year not having been as pronounced as was to be expected.

White lead corroding shed, Eagle-Picher Lead Company, East St. Louis, Ill.

Although lead was one of the first metals known to man and used by him, annually there are new uses found for this most versatile of metals. One of the most interesting of recent years is the use of lead as an anti-knock compound in gasoline. Incidentally, Charles F. Kettering, who first used storage batteries in automobiles, also started the search for something to take the knock out of gasoline, and it was in his General Motors Research Laboratories that tetra-ethyl lead was found most suitable of all the compounds tested. Of course only a minute amount of lead, about 2 grams, goes into a gallon of anti-knock gasoline, but when one considers that more than a billion gallons of this gasoline will probably be used this year, it will be seen that the lead consumed will amount to several thousand tons. Furthermore, the popularity of this kind of motor fuel is increasing so rapidly that, whereas in 1927 only about 2.5 percent of the gasoline consumed in this country contained tetra-ethyl lead, this year the percentage will have risen to about 7.5 percent.

In building construction architects are turning more and more to lead as home owners realize the desirability of getting away from corrodible materials. Lead is the most durable of the common metals and its color is pleasing. Furthermore, there is no danger of lead work staining stone or light-colored paint. Often price considerations preclude the use of lead for roofs, gutters and leaders, and in order to gain some of its advantages large amounts of lead-coated copper are now being used for these purposes on moderate priced buildings.

The outlook for the lead industries should be particularly bright, not only due to the natural (*Cont'd on page* 845)

* Vice President, The Eagle-Picher Lead Company, and Vice President of the Lead Industries Association.

The LEAD Industry of IDAHO

By STANLY A. EASTON *

Lead production well maintained—Metallurgy vastly improved because of fine grinding and selective flotation, which has resulted in an important production of Zinc—Idaho second in rank as lead producer

THOUGH the 1928 lead production from the state of Idaho shows a decline of closely 3 percent from the 1927 production, it is not considered that such unimportant falling off is permanent, but is only a fluctuation. The output of the state is rather well stabilized and is not expected to vary widely from the present figure unless there are unexpected fluctuations in the price of lead, or important new producers are developed. Like so many of the other western states lead production in Idaho has been well maintained and the metallurgy of the lead ores vastly improved because of fine grinding and selective flotation; resulting not only in a larger production of lead but in an important production of zinc, either as a primary product or secondary from lead-silver bearing ores. All of the important lead mines of the state are now producing zinc. In some cases from mill feeds which assay less than 1 percent zinc and heretofore never considered of importance or value, rather an unwelcome menace.

Though over 95 percent of the lead production of Idaho comes from Shoshone County interesting developments and production continue to be made in many other counties. In his 1928 annual report state inspector of mines, Mr. Stewart Campbell, indicates lead resources in 20 Idaho counties, though it is unlikely that more than one-half of these counties have made any lead production of importance. Blaine County, the home of the famous Wood River lead-silver-zinc producing area, which in the early days overshadowed the Coeur d'Alene district, is next in importance to Shoshone County and is followed by Lemhi County with a similar substantial production; these two latter counties are more directly tributary to the Utah smelters and are not feeders of the Shoshone County reduction plants. Better transportation is steadily being developed for the benefit of the central Idaho areas heretofore practically inaccessible and yet difficult of reaching; in spite of their remoteness, high altitude, heavy snowfall and rugged topography, real advance is being made in the development of properties with potential lead production in such areas which, in some measure, will take care of the falling off in production of the older properties.

It is noteworthy that wherever there is a real falling off in the price of lead there is a corresponding falling off, not necessarily in like ratio, of the Idaho lead production for the same year. This reduction in lead output is not from the larger producers, all of which run pretty uniformly as to output irrespective of the lead market, but from the smaller mines and especially lessees who watch the market with extraordinary keenness, even timing their shipments, some of which are of real importance, in order to get the advantage of a change in the New York lead market which may be no greater than 10 or 15 cents per 100 pounds. The change in the market often having a greater (*Continued on page* 845)

Bunker Hill & Sullivan Electrolytic Zinc Plant at Kellogg, Idaho

* Vice President and Manager, Bunker Hill & Sullivan Mining & Concentrating Company, Kellogg, Idaho.

AMERICAN ZINC INSTITUTE'S Research and Market Broadening Plan

By THEODORE MARVIN *

OVER-PRODUCTION merely lack of demand for excess—While decreased production may solve problem, real assistance will come through increasing markets to use surplus—Objectives of a market broadening program outlined

THE situation in which the zinc industry finds itself may be summed up in the phrase, "The potential and quickly available supply far exceeds the natural demand for zinc." This is true, in spite of a relatively large increase since 1921 in the per capita consumption. Three factors have contributed to the increase in the available supply of zinc. These factors are: first—new deposits and the further development of existing deposits; second—technical advancements which have made possible the utilization of ores never before successfully concentrated; and third—the adoption of more efficient methods of smelting and refining.

The effect of these factors began to be felt in 1926 when the price curve of zinc, which had been rising, took a sudden drop. The decline continued through 1927 and the price increase of 1928 was not sufficient to bring it back to a satisfactory level. As a result of this condition, the evils which invariably appear at such times, namely, part-time employment, reduced profits, and idle mills and machinery, have become serious problems.

The zinc industry's situation is not unique; many others have encountered most difficult problems in the past. We have investigated 38 of these industries which were confronted with conditions similar to those the zinc industry now is facing, and which solved them by market broadening work. Among these are cement, wall-paper, brick, kitchen utensils, metal lath, greeting cards, domestic oil heating, lumber, and others of as widely differing industries. In studying the organization of these market broadening associations, the following phases were included: object, general plan of organization and attack, personnel, market surveys and technical research, advertising, and the many other forms of public relations. Throughout these investigations it was clearly evident that it was economically unsound for an individual company or small group to attempt to solve the problems of an entire industry. Results were possible of achievement only by concerted industry action. It is believed that the zinc industry can likewise solve its problems by similar action.

There are two distinct points of approach towards such problems as those with which we are confronted. One begins with the producer, the other with the consumer. The one brings immediate relief; the other provides the greater benefits in the long run. At times both are essential.

It probably is true that over-production is a lack of demand for the excess. Under this condition we have a buyer's market.

Whenever an industry is confronted with a surplus or even a potential surplus so great as to have such an ad-

* Zinc Extension Committee, American Zinc Institute.

verse effect on the market, the first attempt at relief is usually directed toward decreasing production. But curtailment of production alone can not be regarded as the final solution, for, without in any way depreciating the value of this essential procedure, it is but fair to point out that it is comparable to that of an army in war time, which withdraws to take up a previously prepared position in the rear. This procedure may save the army from utter defeat, but it can never win the war. Other plans must be developed which will permit further aggressive action.

Many industries have found that the successful tactics to be employed when such conditions arise consist not in simple reduction of output, but in the creation of new markets, thereby creating an increased demand, equal, or approximately equal to the capacity of the industry to produce. Such a situation exists today in the copper industry where a surplus which glutted the market in 1921 has been successfully disposed and the producers now have more of a sellers' market.

This development of new markets constitutes one of the remarkable advances in business practice which have taken place in the years since the great war.

Competition Between Industries

The most serious competition today is competition between industries and not competition between producers of the same commodity. So we find cigarettes competing against candy; cotton against silk and both against rayon; and in the zinc industry, we find composition roofing, tiles, copper, brass, special alloys of iron, wood products, brick, aluminum, and a host of other products nibbling away at markets which this industry has always felt were peculiarly its own.

This competition is not aimless or misdirected. Let us take those divisions of industry in closest contact. In 1926 there were 33 associations operating in the general construction field, 55 organizations of glass, clay and stone manufacturers, 73 representing the lumber industry, 44 engaged in behalf of the iron and steel producers, while listed as representing producers and fabricators of other nonferrous metals were 30 more. Many of these carry their activities from one end of the country to the other, utilizing every known avenue of market broadening.

In the field of residence construction alone, there are, according to a survey made by the Society for Electrical Development, 27 trade associations sponsoring promotional campaigns directed at the consumer and designed to broaden the market for their own products. Prominent among these associations are Asphalt Shingle and Roofing Association, Association Tile Manufacturers, Copper & Brass Research Association, Hardwood Manufacturers Institute, National Slate Association, Portland Cement Association, Louisiana Red Cypress Institute, and Red Cedar Shingle Manufacturers Association.

With this situation in mind, it seems remarkable that the zinc industry has fared as well as it has. One thing at least has been proved without question and that is: the value and intrinsic worth of zinc's physical and chemical characteristics. Otherwise, its markets would be in a far more unfortunate condition than we find them today.

Objectives of a Market Broadening Program

The chief, and in a sense, the fundamental and basic objective of the program of market broadening is that of increasing sales of zinc and zinc products to the end that increased consumption, without entailing enlarged industry investments, will lower costs and increase profits. The proper development of the zinc industry requires work along the following lines:

(1) Competitive selling activities in known markets.

(2) Study of market possibilities in fields now consuming unknown amounts or no zinc.

(3) Technical studies of zinc in terms of its application to known uses and to new and untried uses.

Market Surveys

So little is known of the ultimate destination of zinc after it leaves the fabricating and converting plants, that there is great need for detailed information before the industry can be properly developed.

Consequently a complete market research should be undertaken to attain the following objectives:

(1) To trace the course of zinc and zinc products from fabricator to consumer.

(2) To classify consumers of zinc and zinc products according to (a): quantity purchased, and (b): use made of zinc.

(3) To study consumption of zinc in its various forms for resulting possibilities of increasing consumption.

(4) To study the relative standing of zinc and its competitors in all divisions of the market and to report the factors operating to hamper the increased use of zinc in these markets.

Technical Research

Opportunities for technical research directed at problems of satisfactory utilization are many and varied. The consumption of zinc in certain industries apparently is now hampered by difficulties of a technical nature, for instance, troubles in zinc coating. Possibilities exist for the application of zinc to purposes for which it never has been used successfully. These applications abound wherever metal or metal substitutes are used. Individual manufacturers here and there, when confronted with such problems have worked out satisfactory solutions, under force of necessity, but this knowledge does practically nothing to broaden the zinc market. It is of value merely in enabling one producer to retain his own trade.

Public Relations and Advertising

Public relations activities and advertising must, of necessity, be preceded by market investigations. Far too many associations and other selling organizations have wasted their appropriations for these purposes by projecting campaigns toward markets of unknown value and importance.

Public relations activities include the introduction of information about zinc to the men who recommend its ultimate use. Among these are architects, contractors, and supply men. The fabricator and other large consumers of zinc constitute important allies who can be reached by news, advertisements, lectures, bulletins, and by association with them at their meetings. These are legitimate avenues of market broadening, and are being utilized energetically by zinc's competitors.

Progress of the Market Broadening Program

It is emphasized that the organization for carrying on this work will function as an entirely separate corporation. Progress to date includes appointment of the organization committee of the Zinc Research Corporation, and inviting zinc mining and smelting companies to join in technical and market research. Although many companies already have joined in the movement, actual placing in effect of the research plans is being held up pending cooperation of other members of the industry.

Effecting the market broadening program (the phases of which will be dictated only by facts secured by market and technical surveys) will bring economic stability and increasing prosperity to the zinc industry through the attaining of the following objectives:

(1) A greatly increased demand for zinc.

(2) Close and mutually satisfactory contact of the industry with the consumer.

(3) Elimination of excessive competition from other products.

(4) Recognition by the consumer of progressive industrial leadership which will attain those benefits always enjoyed by industries whose positions are thusly assured.

(5) Resulting directly from the successful attainment of the above objectives, the industry can confidently look forward to lowered production costs and increased profits.

IMPORTANCE OF ZINC IN INDUSTRY
(from page 840)

metals when it is in the molten state, and hang on grimly after it cools off.

One of the most general applications of zinc, therefore, is what was formerly called galvanizing, and is now preferably termed zincing. Many thousands of tons of zinc are used annually to protect wire, nails, sheets, tubes, pipes, hardware, ship furnishings, and even large structural steel members. Suspension bridges are supported on cables of high tensile strength steel wire, each wire carefully coated with the purest and best zinc. As a protective coating metal, zinc in many fields has no rival.

Then comes brass. How indispensable is brass? What myriad uses this remarkable alloy is put to! Zinc shares with copper in the partnership labeled brass. By varying the relative proportions of zinc and copper, alloys of all kinds seem possible, so that the field brass covers is wide indeed. Go where you may, to the house or to the workshop, brass is always in evidence. Its uses are unending. A worthy substitute for brass would be a modern miracle indeed; and yet industry today must be ever on the alert for miracles.

Zinc is ductile and so can be rolled into strips and sheets and drawn by dies into many shapes for many uses.

Large quantities are used for roofing, particularly abroad. In rolled form we see zinc touching the business of battery makers, of stampers in metals, or roofers, of electrotypers, and of a host of others.

The idea of quantity production, the making of much in little time, has opened up a new field for zinc—the die-casting industry. This method is superseding the old slow method of casting small articles. Individual molds for each casting were relatively cheap, but the making of many molds was slow and expensive. In die casting the mold often costs a lot of money, but hundreds of thousands of castings may come out of one mold. Furthermore, the castings are precise and alike.

This development, die casting, was just what the automobile industry wanted, to provide it with door handles and similar hardware. Now it so happens that zinc is the metal for this work. Its low melting point helps conserve the dies, and it flows nicely into all the delicate intricacies of the design. Very pure zinc is required, and the best results are attained with small additions of copper, aluminum, and magnesium. The die-casting industry is growing rapidly, and it is probably destined to extend far beyond its present limits. Zinc will probably profit immensely by this expansion.

Turning from metallic uses, zinc is met as a fine, beautifully white powder devoted to the adornment of the faces of the fairer sex as well as the walls of the houses they deign to grace with their presence. From house paint to face powder may seem a far cry, but tons on tons of zinc oxide are used for both. Devoid of poisonous effects, zinc oxide, by reason of its fineness of texture, clear whiteness, and its miscibility with oils, is an ideal pigment.

The same material, zinc oxide, is used extensively by rubber manufacturers, as it aids in the curing of rubber. It also adds to the resistance to abrasion which is so necessary in rubber tires, and it helps to conduct away the destructive heat formed by friction and compression of tires on the road. It is one of the necessary elements, therefore, in the compound that has enabled the tire maker to put the automobile industry on its feet, so to speak.

This short review illustrates, though imperfectly perhaps, the many and varied ways zinc is an essential element in industry. In fact, it is one of the prime necessities. While the quantities used may vary from time to time in this direction or in that, the gains are always larger than the losses, and as the years roll on it may be confidently predicted that more and more zinc will be required by industry, and more and more zinc will be produced to meet its many necessities.

Shovelling and drilling a "spitter" on a high heading in a zinc mine

USE OF LEAD IN INDUSTRY
(from page 841)

increased demand for lead that has already been mentioned, but also due to the attitude within the industry itself. The formation of the Lead Industries Association late last year, embracing producers and consumers alike, presaged a new era of cooperation and better understanding within the industry. This Association is now furnishing statistical information to both buyers and sellers which should be of material aid in eliminating blind policies necessitated in the past because of lack of information. It will probably soon be ready to embark on programs of technical and market research to widen the outlets for lead, and in many other ways should prove itself of service to the industry.

LEAD INDUSTRY OF IDAHO
(from page 842)

effect upon the imagination and spirits of these lessees than upon their financial prosperity.

Idaho is again back in second place among the states as a lead producer, it is not expected it will ever be first among the states in this respect but I think can be safely counted upon to be next to Missouri for some decades to come in the production of metallic lead.

RATE OF STOCK COLUMN DESCENT IN LEAD BLAST FURNACE

Interesting observations on the rate of the descent of the stock column and the formation of accretions have been made in a study of the conditions obtaining with a lead blast furnace of a Utah smelting company conducted by the Intermountain Experiment Station of the United States Bureau of Mines.

The data show that the rates of smelting in various parts of the furnace can not be calculated directly by measuring the rates of subsidence of various areas at the surface of the charge, due to lateral movement of the charge in the furnace, and to other irregularities in the descent of the stock column caused by accretions in the shaft of the furnace. In general, the rate of subsidence is fastest over the slag tap end, or front of the furnace.

The analyses and method of occurrence of these accretions suggest that they build a shoulder outward at the zone of incipient fusion by the sticking of infusible material to the pasty sulphides. The more fusible constituents (assisted perhaps in their formation by some chemical interactions) as metallic lead and sulphides, filter inward into the accretions as time goes on. The accretions are thus modified in nature and made more solid.

The Tri-State District FROM THE AIR

U. S. Geological Survey, U. S. Army Air Corps and Picher, Okla., Chamber of Commerce in a Government-industrial cooperative effort have produced an aerial mosaic map of Oklahoma lead and zinc mining districts which has been extremely helpful in supervision of mining leases

By C. F. WILLIAMS *

WITH the increasing multiplicity and complexity of mining operations on the restricted Indian lands in the Oklahoma portion of the Tri-State zinc and lead district, the need for an accurate aerial map of the mining area, in connection with the supervision of mining leases on the Quapaw reservation, became most apparent. Many maps showing topography, mine locations, and other features were available but they were not sufficient to meet all requirements. There were a few oblique aerial photographs available and while interesting their principal value was as an indication of what might be expected from an aerial mosaic. It remained for a governmental-industrial cooperative effort to solve the difficulty and furnish such a mosaic.

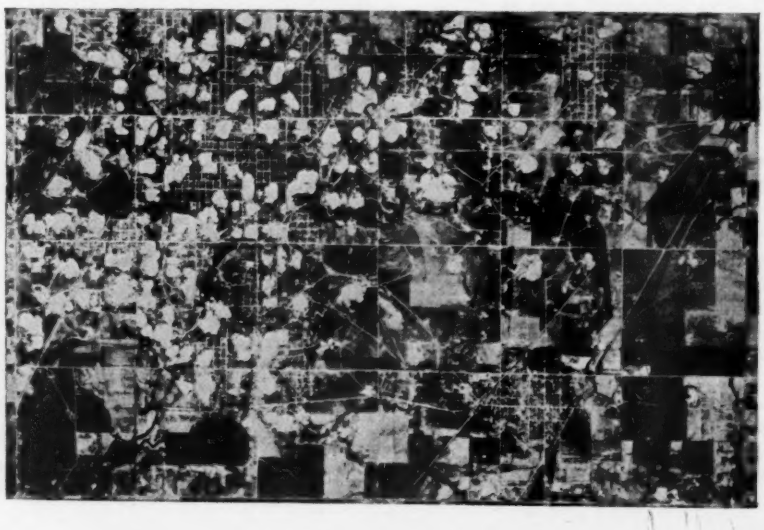
Arrangements were made by H. I. Smith, chief mining supervisor of the Geological Survey, for making an aerial mosaic by cooperation between the

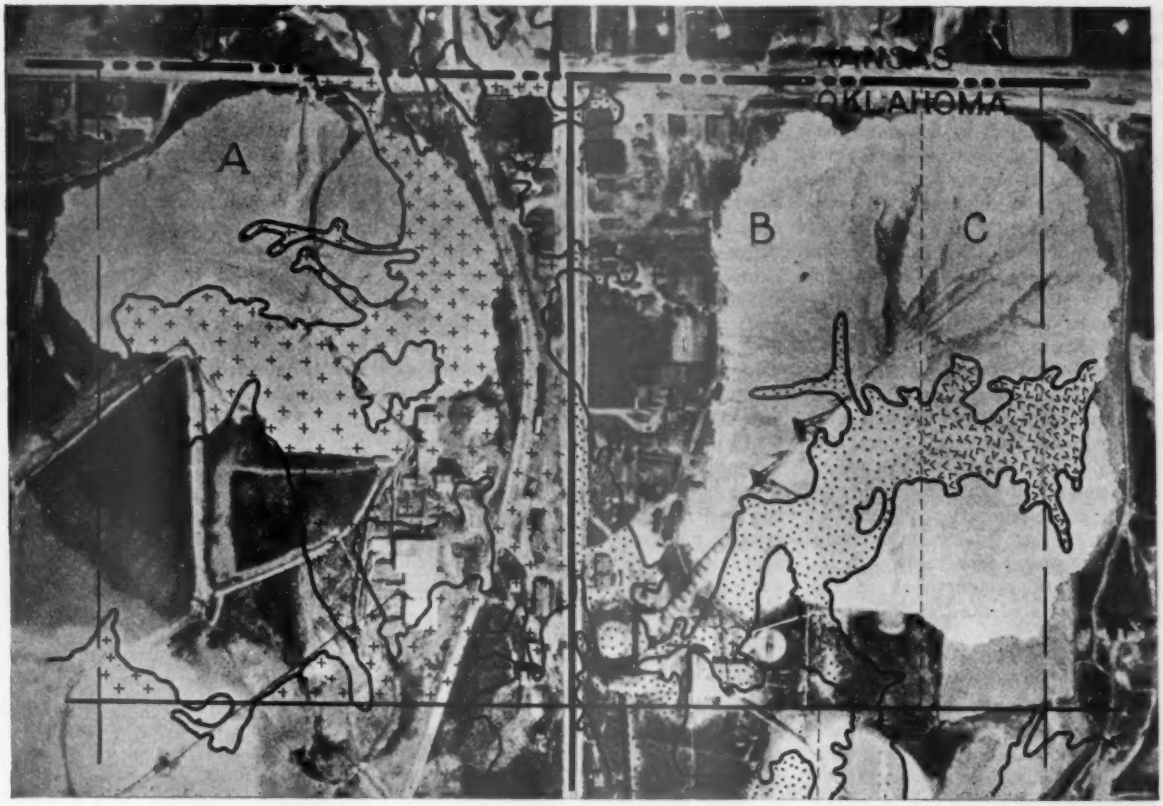
* District Mining Supervisor, U. S. Geological Survey, Miami, Okla.

Published with permission of the Director of the U. S. Geological Survey.

The illustration at the top of this page is the mosaic of the Oklahoma section of the Tri-State zinc and lead district showing the field as a whole. In the eastern portion of the mosaic will be noted the Spring River, which at present is the eastern border of the zinc mining district in Oklahoma. In the northern central portion of the photograph are a number of white blotches; these are the tailing or "chat" piles, the residue from milling operations. An interesting feature of this mosaic is the clarity with which one can note the break-off line between the mining operations in the Picher field proper and those around Commerce, in the southwestern part of the photograph.

To the right is an enlargement of the eastern portion of the field around Quapaw. Note drill holes in the NW¼ of the section in the lower left-hand corner.



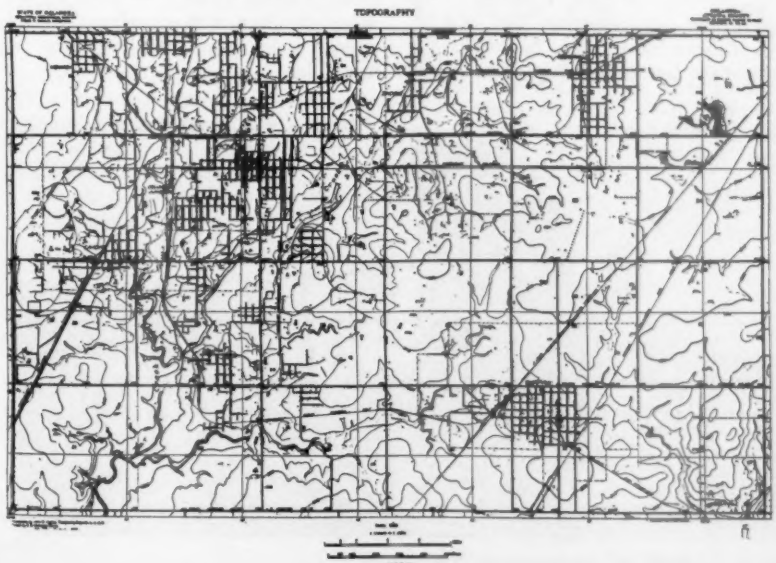


Chamber of Commerce of Picher, Okla., the U. S. Geological Survey, and the U. S. Army Air Corps.

On April 5, 1927, Pilot First Lieut. Alfred L. Jewett and Observer Master Sergeant Paul H. Dawkins, 9th Photo Section, A. C., departed from Fort Riley, Kans., at 7.30 a. m., in the aeroplane Minerva, with instructions to take photographs of the Quapaw Indian reservation and return to Marshall Field upon the completion of the mission.

The photographs were taken from an altitude of about 10,000 ft. and a total of more than 300 negatives were exposed. The completed mosaic is about 5 ft. by 10 ft. in size and shows the principal producing mines in the center of the Tri-State District, extending from Baxter Springs, Kans., on the northeast to Miami, Okla., on the southwest. Such details as cultural features, power transmission lines and churn drill hole locations, which were indicated by the sludge around the collar of the hole, show up with remarkable clarity.

Lettering on the above illustration indicates (A) Goodwin Mine, Eagle-Picher Lead Company on fee-owned land; (B) Swift Mine, Eagle-Picher Lead Company on the allotment of Mary Whitebird, Quapaw Indian ward of Government; (C) Moore Mine, Eagle-Picher Lead Company on the allotment of Mary Whitebird, Quapaw Indian ward of Government. This enlargement of the mosaic shows the tailing, or chat piles, of the Swift and Goodwin mines. The Swift and Moore mines are on restricted Indian lands which are a portion of the Mary Whitebird allotment. The enlargement also shows the underground workings of those same mines superimposed on the photograph.



A topographic map on the same scale, of the same area as the illustration at the left. From these two, interesting comparisons can be made.

After the photographs were taken the War Department turned over the negatives to the Department of the Interior. Technicians of the aerial photographic section of the Geological Survey calculated the ratio of increase or decrease in the scale of the individual prints to conform to a scale of one in ten thousand, or 833 1/3 ft. to the inch. Such work is necessary in the making of precise mosaics. The uncorrected contact prints were not to exact scale due to variation in the height of the airplane from the ground and variation in the ground itself away from a horizontal plane and by the tilting of the camera axis at the instant of making the exposure.

The negatives with a memorandum of

the required corrections, were then sent to a commercial concern where the finished ratio-prints were made to correct scale and matched relative to intensity and color. The Survey technicians then cut the photographs on irregular outlines, and matched them so as to give the minimum distortion. The photographs overlapped approximately two-thirds, so that only about one-third of each print was used. Tangents of roads and railroads were used for orientation and points in common were placed directly over the same points on the base map showing these features.

The topography can be contoured by parallax measurements. Because ground control is required only to the extent of about four known points per picture, this method reduces the field work to approximately one-half of that otherwise necessary in the preparation of contour maps. The finished Quapaw mosaic was used by Government topographers in revising the 10-ft. contour map of the Oklahoma section of the Tri-State mining district.

In connection with the supervision of the departmental lead and zinc mining leases in the Quapaw Indian reservation, Oklahoma, and more particularly in the matter of the accurate location and relation of tailing piles, slime ponds, roads and railroads, mine plants and buildings located upon restricted Indian land within the reservation, the aerial photograph of the mining district has proved invaluable, not only to the Office of Indian Affairs and the Geological Survey, but to the many departmental lessees as well.

The Quapaw reservation is approximately 6 miles in width and 16 miles in length. The mineralized area under departmental lease is covered by a rectangle 6 by 11 miles containing 66 square miles. The terrain of the producing area is generally flat prairie land and the road net generally coincides with the legal subdivisions.

The lead and zinc mines located upon restricted Indian land in the Quapaw Indian Agency, produce approximately one-quarter of the primary zinc produced in the United States. The Indian wards of the Government receive nearly $2,000,000 a year in the royalties and rentals from these lands.

All of the lead and zinc ores in the northeastern Oklahoma district are covered by thick beds of sedimentary rocks; hence all prospecting is done either by churn drilling from the surface or by underground development drifts. Six and one-fourth-inch churn drills are standard for drill holes up to 300-ft. depths. The cuttings are examined as drilling progresses and when by estimate over 2 percent zinc blend or 1 percent of lead sulphide is encountered, the cuttings are assayed. When the zinc blend is found in a less quantity than 1 percent the log is marked "shine." The ore usually mills out at about 10 percent above the assay indication of the drill cuttings. With the dependence thus placed on prospecting by drilling it is important that any area be carefully examined for drilling and that places not thoroughly drilled be indicated for future exploration. The possibility of finding more ore in an area is largely indicated by the intensity of previous drilling but frequently, the logs of the old holes have been misplaced and their assay records lost. The aerial pictures have also been a great help in locating insufficiently-drilled areas, especially around abandoned mines where the maps with drill locations have been lost or destroyed. This mosaic will thus result in increasing the royalty returns to the Indian owners by the pointing out of areas in which further prospecting should be conducted or other abandoned areas where previous drilling should be checked.

The mosaic also enables the Government engineers to make a survey of the tailings now on restricted land and assists in drawing up plans to provide for more space for tailing disposition, water supply and lease consolidation, all problems of increasing importance.

The ability of the aerial camera to accurately map difficult or inaccessible terrain is finding a wide field of application in industry. Developed as an essential military accessory to operations on the Western Front, the technic of photographic mosaic fabrication has been applied to many industrial problems with marked success.

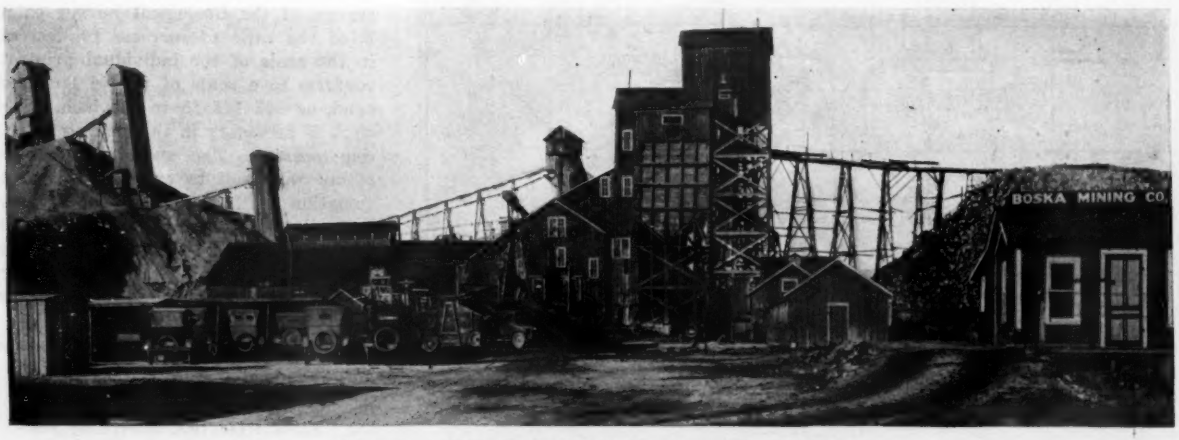
No copies of the aerial mosaic are available for general distribution. The official copies may be consulted, however, by any one interested, at the Geological Survey offices in Washington, D. C., or Miami, Okla.

REACTION OF METALLIC IRON AND COPPER SULPHATE

In the flotation of sphalerite the use of copper sulphate as an activating agent has become almost universal. Metallic iron also is present in the mill circuit and the abundance of this material may be noted by even perfunctory examination of almost any flotation feed.

Experimental work conducted at the Mississippi Valley Experiment Station of the Bureau of Mines, in cooperation with the Missouri School of Mines and Metallurgy, Rolla, Mo., has shown that the presence of metallic iron is harmful to the flotation of sphalerite when copper sulphate is employed, even though the circuit is neutral or slightly alkaline. If a flotation pulp is allowed to become acid, undoubtedly metallic iron is injurious, and even if alkalinity is maintained the iron may prove a menace.

The losses of sphalerite were not great when the amount of iron was small but increased progressively as the quantity of the iron was increased. Any increase in the amount of copper sulphate over that necessary to float the sphalerite was harmful when metallic iron was present. When no iron was present the same amount of copper sulphate was not harmful.



Zinc plant of the Boska Mining Company, Miami, Okla.

Recent Developments in MILLING PRACTICE in the Tri-State District

By C. O. ANDERSON *

Milling methods controlled by life of mine and location—Present-day ores growing leaner—Hand picking occasionally favored—One-fifth present zinc produced by flotation—Demand for flotation concentrates increasing

THIS DISTRICT is called the "Tri-State," as the mining field lies where southwestern Missouri joins southeastern Kansas near Joplin, Mo., and Galena, Kans., and where northeastern Oklahoma joins southeastern Kansas near Picher, Okla., and Baxter Springs, Kans. Before the War the Missouri part of the field was the principal producer. In 1915, however, active mining began in Picher, Okla., which lies adjacent to the Kansas-Oklahoma line. Relatively little mining has been done in the Missouri field since the war, whereas the mineral areas in the Kansas and Oklahoma parts of the district have been developed and operated intensively. For example, the production for the three states for 1928 was as follows:

	Zinc Concentrates		Lead Concentrates	
	Tons	Value	Tons	Value
Oklahoma ...	370,960	$14,482,785	62,617	$5,117,620
Kansas	208,115	8,082,397	34,953	2,860,392
Missouri	18,307	714,045	1,113	90,337
	597,382	$23,279,227	98,683	$8,068,349

Thus of the zinc concentrates Missouri produced in 1928 only about 3 percent, Oklahoma 62 percent and Kansas 35 percent. Of the lead concentrates Missouri contributed only slightly more than 1.0 percent, Oklahoma almost 64 percent, and Kansas 35 percent. The zinc and lead occur in relatively the same quantities in the different states.

The value of the zinc and lead concentrates for 1928 was about $31,300,000, which represents a considerable decrease from the peak figure of $59,400,000 for 1925. The importance of this district as a zinc producer may be judged by the statement that it produced in 1926 more than 66 percent of the United States total of recoverable zinc as metal and although its activities were relatively much curtailed in 1928 it produced about 46 percent of the country's total.

The active mining area today lies on both sides of the Kansas-Oklahoma line with Picher, Okla., as its center, with Commerce, Okla., at its southern extremity and with Baxter Springs on its northern edge. The large majority of the mines lies in an area about five miles by eight miles. From less than 100 to about 135 mills have operated during various weeks of 1929. So many mills in such a small area means, of course, that often mills are located close to each other, as on adjoining 40-acre tracts. The multiplicity of mills together with the fairly short life of the average mine, from 2 to as much as 10 years, has had an important influence on the kind of mills built and on the milling methods, particularly on the refinements employed.

Something is known in nearly every mining camp the world over of the old Joplin type of mill wherein a small jaw crusher, a few sets of Cornish slow-speed rolls, two or three Cooley type of Harz jigs and perhaps a few inexpensive tables comprised the concentrating equipment. The ores of the Missouri part of the district were and are quite free-milling; the galena and blende were freed readily from the associated flint and limestone. When mines were opened in the Picher field the same type of mill was built there, but soon it was recognized that such mills dealt very inefficiently with those ores which were richer in mineral content and much more disseminated in a tougher, harder flint. Usually the galena was coarsely crystalline and readily recoverable except in the slimes. The blende, although much of it was liberated when the ore was crushed through ½ in., persisted as "chat" grains (local term usually applied to a grain composed of blende and flint) to about 35 mesh. Because of the dissemination much mineral was lost as chats and because of the richness of the ores and the hardness of the flint heavy losses were sustained during the war years and those immediately following. At this time very few technical men were in the district and but little attention was given to decreasing these losses or improving the mills. In the last seven years many technical men have come to the field and much time has been devoted to milling and metallurgical improvement. The ores mined today are on the average much leaner than those of a decade ago; the combined lead and zinc recovery for the district (tons concentrates per 100 tons ore milled) was about 6.8 percent in 1928, of which approximately 1.0 percent was lead. Needless to say that this

* Metallurgist, Century Zinc Company.

A panorama of part of Picher, Okla.

district would be operating on a very small scale today if milling methods had not been changed and improved. Except for the addition of flotation as an auxiliary process, the Tri-State mill of 1929 has the essentials of jaw crusher, rolls, jigs and tables found in the old Joplin mill, but they have been improved so that the average present Tri-State mill is a fairly efficient concentrator.

The subject of mills may be discussed under the four headings into which mills divide themselves usually as regards departments, namely, crushing, jigging, tabling and flotation. Milling may be considered from the metallurgical standpoint of treatment and recovery of mineral in chats (locked mineral) and in slime. As already mentioned, the concentration of the galena presents no particular problems except in the slime sizes; the amount of lead chats or middlings is negligible usually and receives scant attention. Free blende is concentrated very effectively, but zinc chats and zinc slimes have been the subjects of most of the metallurgical studies in the Tri-State mills. This paper will discuss mills and milling under the four divisions of a mill and attempt to indicate under each the influence the metallurgical studies of chats and slime principally have had in effecting changes and improvements. This represents an ambitious task, so of necessity much must be left unsaid and yet, it is hoped, the reader will have a fair picture of mills and milling in this district in 1929.

Crushing Department

Under crushing we have reference primarily to all breaking before concentration on jigs begins. In the average mills of a few years ago the ore from the mine was hoisted in the usual tub or can and dumped onto a grizzly made of heavy rail and spaced varying from 6 to 11 in. Depending on the spacing and on the tonnage handled, three or more grizzly men or "screen apes" discarded the large barren boulders and broke with sledge the others which joined the finer rock in the hopper immediately below the grizzly. From the hopper the crusher feeder allowed the ore to pass directly into a jaw crusher of the Blake type with width of jaw opening from 14 to 24 in. From the crusher the rock passed to the slow-speed Cornish "breaker" rolls and thence to the "dirt" elevator which in turn fed the dirt screen (⅜-in. to 9/16-in. round-hole opening). This screen was in closed circuit with the Cornish "return" rolls and the dirt elevator. In many of the mills today numerous variations from this procedure may be noted. The grizzlies have been eliminated in most cases and rarely does a mill now have a boulder pile. All rock hoisted is milled. Larger crushers are being used; the size 9-in. to 12-in. x 24-in. is quite common. Safety regulations require that no boulder weighing more than 50 pounds may be loaded underground. This rule is not obeyed always by the miner and often the 24-in. crusher has an excessive burden imposed on it by quite a large boulder. Formerly the hopper load literally leaned against the crusher and this, of course, meant choked feed and little opportunity for removing tramp iron and trash. Now belt feeders are interposed in some mills between the hopper and the crusher; these may be started and stopped at will by the crusher feeder and permit removal of much foreign material. Sometimes the head pulley of this feeder is magnetic and protects the crushing equipment against tramp iron of all descriptions. Some mills have spaced rolls with large diameter shells (51-in. and more) in place of the slow-speed Cornish rolls (36-in. to 51-in. diameter shells). Spaced rolls decrease sliming of mineral and because of their greater weight are more effective crushing devices. High-speed rolls (60 to 75 r. p. m.) are often used as "return" rolls and for grinding chat or middling products through sizes from ¼-in. to 1½-mm.

In most mills, however, the crushed rock goes directly from the crushing plant to the jigging department and hence the jigs and, of course, the tabling and flotation sections feel the full effect of all irregularities in the crushing plant as to fines and coarse rock. Ordinarily, during one part of the day the crusher receives mostly boulders and then perhaps in the afternoon a rush of fine dirt ensues. Under such conditions it is virtually impossible to adjust the concentrating equipment to treat efficiently such a variable load as to size, quantity and richness; the boulders are lean and the fines are rich. To remedy this condition a few of the most modern mills built in the last two or three years have installed a separate crushing plant which discharges a partially or completely crushed mill feed into an intermediate hopper from which the mill may draw quite a uniform and regular quantity of feed as to size and mineral content.

To contend with large boulders from the mine and to handle larger tonnages much attention has been given to designing larger and better crushers. Almost without exception crushing equipment is built by local firms. Crushers with as much width of opening as 36 in. are now in satisfactory operation in a few of the newer mills.

In these larger crushers the problem of lubrication has been considered fully and separate oilers with six feeds serve the machine. The method of water cooling has been well designed.

Larger and larger rolls have been built and used until now some of 66-in. diameter are employed for breaker and return rolls. The desire to use larger rolls has been prompted in part by the wish to nip successfully and crush larger pieces until now often 6-in. pieces of rock pass to these big rolls. The severe duty thus imposed on the rolls has aroused question of the desirability of this procedure, and has created much discussion as to substituting a secondary jaw crusher for these breaker rolls and reserving the rolls for crushing rock of 2½ to 2 in. diameter and finer. Already in one or two instances the effectiveness of a secondary crusher has been demonstrated. The tendency today in the crushing plant of the Tri-State mill is toward a large jaw crusher followed by a secondary reduction crusher to break the rock to about 2½ in. or 2 in., then send this material to a secondary hopper from which the concentrating plant is fed steadily a uniform quantity or complete the crushing to ½ in. or 9/16 in. before sending the dirt to the feed hopper. Screens may be inserted ahead of or between crushers and ahead of the rolls to remove fines and thus decrease wear and tear, reduce sliming and increase capacity. More magnetic devices will be used to remove tramp iron.

Prompting all of the changes in the crushing department has been the desire to decrease sliming of mineral to some degree and primarily to provide the concentrating departments with a steady uniform feed so that the isolation and treatment of the chat grains will be more effective.

Along with these changes in the crushing plant has been the increased use of steel such as manganese and other compositions in place of the usual hard or cast iron. Steel jaws, side plates, bumpers, cheek and breast plates, etc., in crushers and steel shells and parts for rolls has increased tremendously in recent years. Longer life with less lost time for changes and actual economy in crushing costs have caused the district to adopt steel.

Hand-picking as a method of concentration almost belongs to a past era but in one mill in this district it has been revived and applied quite successfully. The rock hoisted passes through a 36-in. jaw crusher, after which it is screened at about 2 in. and the oversize washed free from adhering fines. The coarse passes to picking belts from which are removed the *mineralized pieces* and the barren flint is sent directly to waste. According to the company, more than one-third of the total tonnage hoisted is discarded as waste over the picking belt. As the ore is lean, about 4 percent blende, only a very small tonnage is actually moved by the pickers. Of course their principal duty is to see that no mineral escapes over the end of the picking belt. The material milled represents less than two-thirds of the ton-

Wilbur Mine, Commerce Mining and Royalty Company, Miami, Okla.

nage hoisted and has an increased metal content. A material reduction in milling cost per ton hoisted is reported.

Had barren flint been picked, too much tonnage would have had to be moved and no economy in operating cost would have occurred. The ore at this mine is of the sheet ground type near Baxter Springs; it is lean and rather free from chats. Other companies treating ores of this type are considering hand-picking since large tonnages must be handled per day to be profitable and the milling cost should be reduced if possible.

When certain facts are considered, it is barely possible that hand-picking may be applied to the chattier ores of the district. For example, in an ore crushed through ½-in. and having a composite assay of 6 to 7 percent blende the coarser sizes above, say, ¼-in. will have a tenor of 3 percent or slightly more and this will increase with decreasing size until the minus 100-mesh material will assay about 18 percent blende. The mentioned coarser sizes will constitute 40 percent of the weight and contain 75 percent virtually barren flint. Not many mineralized pieces would have to be removed to render the plus ¼-in. portion a tailing of tenor of 1.0 to 1.50 percent. In like manner if this ore were crushed through 4 in., the plus 2 in. would contain 40 to 50 percent of the total weight and assay a scant 3.0 percent blende. Very few percent weight of mineral-bearing pieces would have to be removed to enable the rejection of a waste product of about 1.0 percent blende content. As this district is required to mine the leaner ores and as it progresses in the tendency to handle greater tonnages per day and as it faces the unprofitable prospect of grinding the entire rougher jig tailing to flotation fineness, the applicability of hand-picking the mineralized pieces will be considered thoroughly.

The old Joplin mill was of wooden construction, frame work, sides, roof, floor and all. Then galvanized-iron siding and roofing with wooden framework became popular and is very common today. However, some of the largest and newest mills now are almost entirely of steel and concrete construction with galvanized-iron sides and roof.

The usual requirement of a mill on each 40-acre lease has resulted in the past in the multiplicity of small-tonnage mills; the average life of a mill was also considered short. However, in recent years the tonnage handled per hour in nearly every mill has been increased approximately 50 percent so that a tonnage of 40 tons per hour is now quite common. The newer mills have capacities up to double this quantity. The majority of the mills operate only 10 hours per day and because of overproduction have undergone in the past two years several curtailment periods. Because of short life of mines and because of relatively small tonnages handled, many metallurgical refinements in use in mills in other districts have been and still are absent in the Tri-State mills.

Jigging Department

The ore wet ground through 7/16 in. to 9/16 in. passes from the "dirt" screen to a deslimer of the drag or of the cone type, the discharge of which goes to the rougher jig and the overflow to the table department. As already mentioned, the mineral is segregated in the fine sizes and hence it is important to obtain through removal of the slimes from the jig feeds. Automatic desliming cones, such as the Wood, the Boylan and the De Mier, are in common use in the jig mills for dewatering and desliming feeds as well as tailings in the jigging department. Homemade drag deslimers patterned after the old Esperanza type have been perfected so that they perform quite well and are in use in a great many mills. Drags of the Dorr and Akins types are employed occasionally but have not had widespread use primarily because of their higher first cost. In recent years it has become almost an axiom to dewater and deslime at every opportunity in the jig mill; the slimes carry high values and their removal facilitates the jigging of the coarser sizes. This desliming occurs generally at the head end and at the tail end of every jig, whether it be rougher, cleaner or retreatment jig.

The rougher-cleaner system is used in every jig mill; the ore first passes over a rougher jig which discards a finished tailing except for further desliming, and which yields bed material and hutch products (smittem) whose concentration is finished on a cleaner jig which produces both lead and zinc concentrates. From the rougher jig is drawn also chat or middling products through chatters or draws usually located above sieve level. Many types of chatters are in use, but most of them are patterned after the pipe (1½-in. to 2-in. diameter) which is laid across the end of the jig cell and protrudes through the side of the cell; the pipe has openings in its side round, square or slot, and these may or may not face toward the oncoming ore charge. The coarsest chat grains are recovered fairly well by these chatters, the fine chats (smaller than 2 mm.) pass quite readily into the hutch but the intermediate chats (3/16-in. to 2-mm.) are difficult to isolate. Much study has been devoted to length of jig strokes, depth of cells, size of openings in sieve cloths, etc., in the effort to recover the chat grains. He who attempts to improve the jigging of today faces several difficult facts, such as the wide range of sizes treated on a particular jig, removing chats to conform to the rate at which they stratify in the jig cell, many chat grains assaying several percent blende have virtually the same specific gravity as some of the barren gangue, etc. Rougher jig tailings in this district will vary, depending on character of ore and milling conditions, from less than 1.0 percent blende to more than 2.0 percent blende; this tailing constitutes 70 to 75 percent of the total mill tailing.

Sizing before jigging has been attempted in the effort to improve extraction of chat grains, but sizing has been abandoned usually because of inefficiency of the screens available.

The trommel screen was used in practically every mill until the last few years. Not many screens, such as the Leahy Vibrator, the Tyler Hummer, the Colorado Iron Works Impact and others, are employed with consequent increased efficiencies; the most recent entrants into the district are the Niagara and the Robins Gyrex. These latter two, because of their rugged construction and intense efficient screening action, will no doubt come into general use soon. Both punched plate and woven wire cloth are employed on all of these screens.

The chats drawn from the rougher jig, and the cleaner jig tailing which is largely a chat product are ground usually in slow-speed or high-speed rolls and rejigged either on the rougher jig or on a separate jig such as a chat rougher, a sand rougher or a sand cleaner. These chats are ground not finer than 2 mm. and generally not less than through ⅛-in. (3-mm.). Ball mills or rod mills are seldom used on material coarser than ⅛ in. and in like manner is the increasing tendency to use rolls to grind not finer than to this size.

The use of ball and rod mills has become popular in the last three years, so that now about 50 of these machines are in operation; less than 10 rod mills are in this number. Virtually all the prominent manufacturers of such grinding devices are represented in the district.

Thus far these grinding mills have been fed quite a variety of chat products from both the jig and table departments and have often been a catch-all for products that could not readily be sent elsewhere in the mill. In most installations the ball or rod mill has been in open circuit; sometimes a portion of their discharge returns as table middlings. No Tri-State mill boasts of two of these devices in parallel circuits, and it is doubtful whether any two plants in the district have identical feeds for their ball mills. Under such conditions no real standards of performance have been set up. But regardless of these facts the ball mill has come to stay in the Tri-State mill, will increase in its usefulness and will sooner or later find its proper niche in the milling scheme. Whether it belongs in the jig or table department is difficult to say, as it usually receives much of its feed from the jigs and sends its discharge to the tables.

In the last two or three years the familiar 2-in. x 4-in. or 2-in. x 6-in. wooden construction Cooley type of Harz jig has been replaced in many mills by the semi-cylindrical bottomed steel jig, an all-electrically welded machine. The design of the steel jigs has been perfected largely in the last two years, so that now they are generally accepted as superior to their wooden predecessors. The steel jig weighs less than one-half that of the wooden jig, permits a more uniform jigging action and should have a longer life by many years.

Usually hydraulic water for jigs is introduced *above* the plunger, but in some mills now each jig cell has its water come *under* the plunger through a separate pipe line with individual valve control. Water under the plunger is more positive in its action than water on top of the plunger. Steel jigs with water introduced under the plungers are probably the best jigging devices in this district today.

In the mill of 10 years ago water was pumped by belt-driven pumps to an elevated tank from which it flowed to various consuming points in the mill. Direct-connected pumps raising water to jig level where the bulk of it is used are in widespread use now. Booster pumps elevate water to the higher points where it may be required. Much economy of power has thus resulted.

Nearly all of the changes and improvements in the jigging department have been aimed primarily at removing more of the slime and isolating more chat grains; of course, many of the changes have made some economies in operation.

Table Department

All of jig department overflow products, sands from the cleaner and the sand jigs and usually the ball mill discharge pass to some kind of dewatering and desliming device whose overflow goes to the flotation feed thickener and whose sand discharge passes to the table room feed elevator. Quite a variety of devices serve for this dewatering and desliming task. The one most common a few years ago but now passing rapidly out of use is the wooden sand tank into which the overflows and sand went for an interval until a quantity of sand had accumulated, then the flow was switched to another tank and the contents of the first was washed into the feed elevator. Of course this procedure resulted in a very irregular feed to the tables. The continuous devices fall into three classes, cones, drags and thickeners. Cones, both of the automatic type and of the common type with a molasses gate spigot discharge have been employed in many mills. The live-feed drag which is simply a larger drag (up to 100 ft. settling area) than those used in the jig department, has been developed in this district in the last five or six years and is now used in a great many mills. In a few cases a small thickener 12 ft. to 16 ft. in diameter has been employed. The watery discharge from cones and thickeners has militated against them and reacted in favor of the drag. However, the drag is large and bulky and difficult to get under cover of the mill, so if the problem of a drier discharge can be solved thickeners may come into more use for this duty.

From the table room feed elevator the sands pass through a screen with 1½ to 2-mm. openings. The oversize which is usually tramp material may pass to one of several places, such as the jig department, the ball mill or to waste. The undersize is deslimed further and may be classified before passing to the tables. Homemade drags, cones, Dorr and Akins drags are used in this desliming.

As to preparation of table feed the district is divided in thought. One favors thorough desliming followed by a distributed feed to the tables, which, of course, means the same character of feed on each table. The other class practices desliming followed by classification into a number of table feeds. In the last year the constriction plate classifier as used in the Southeast Missouri Lead Belt has been introduced into this district and has performed quite satisfactorily in a number of mills. As to whether "distributed feed or classification" will predominate in the future is difficult to predict, yet the probable tendency will be towards the latter.

The screening at the head of the table departments has always been a problem, as fine screens are inefficient. In a few mills where the constriction plate classifier has been installed the screening problem has been almost eliminated by using a screen with ¼ to 5/16-in. openings to remove trash and then utilize the first compartment of the classifier to catch any coarse pieces and sending this material to the ball-mill circuit.

In many mills table middlings are sent to the ball-mill circuit, but this means of course sliming of some free mineral in the effort to grind some small chats. Considered from some angles the table room should receive very few chat grains. The overflows in the jigging department if properly adjusted do not contain chat grains (zinc blende is liberated quite thoroughly at 35 mesh). The small chats in the mill feed pass readily into the rougher jig hutches and appear in greatest concentration in the cleaner jig tailing. This product, together with certain hutch products from chat treatment jigs if kept in grinding circuits until the contained mineral were liberated would permit the table department to receive a chat-free feed and obviate necessity of regrinding table middlings. In a few mills work has been done along this line in the last year.

In some quarters serious consideration has been given to the elimination of table rooms and have a concentrator consisting of jigging department, a ball-mill section for regrinding all or a portion of the rougher jig tailings and other products, and a flotation plant wherein coarser material will be floated than that today. The increasingly urgent demand for flotation concentrates by the smelters may or may not facilitate the passing of the table department, as under these conditions some favor the elimination of the jigs and initial crushing of the mill feed to table size before concentration begins. The probabilities are that the Tri-State mills will have both jig and table departments for some years to come.

Elevators in the table department as well as in the flotation section are being replaced by sand pumps such as the Wilfley, the Butchart and the Carthage. Many table and flotation departments have but one elevator now, the table-room feed, and (*Continued on page* 893)

(1) *Safety Engineers' Organization of the Tri-State District, meeting at the offices of the Tri-State Zinc and Lead Ore Producers' Association, Picher, Okla., March 27, 1929. (Full caption at foot of page.)*

ACCIDENT PREVENTION in the Tri-State District

Producers' association in cooperation with individual companies and U. S. Bureau of Mines inaugurated intensive safety campaign in 1924, which has resulted in enormous saving of lives—The plan adopted in this campaign and the methods of carrying it out, together with the results obtained, fully outlined

By H. W. GIESSING*

IN 1924 the Tri-State Zinc and Lead Ore Producers Association, together with other mining organizations in the Tri-State District, was led to inaugurate an energetic campaign for accident prevention, which was made urgent by the increasing frequency and severity of mine accidents in the district. This work was undertaken primarily to decrease the number of preventable accidents in the mines and mills, and to improve the general working conditions for the men employed. It was expected also that there would result a lowering in the rates paid for compensation insurance, as these rates were becoming increasingly burdensome.

Following a careful survey of existing conditions and of past experiences in the district, the Producers Association employed Mr. R. V. Ageton, formerly with the United States Bureau of Mines, as safety engineer to supervise and coordinate the work throughout the district. Technical employes of individual companies were assigned to part-time and in many cases full-time safety work. Weekly meetings of these safety engineers were held at the headquarters of the association in Picher, Okla. At these meetings accidents, hazards, and corrective measures were discussed and safe practices and safety devices were thus standardized, for the mining conditions throughout the district are the same. Mr. Ageton was later succeeded by Mr. F. H. Nesbitt, who is the present safety engineer for the Producers Association. An accompanying illustration (No. 1) shows the safety engineer's organization.

Along with the inauguration of the accident prevention work, a study of health conditions was begun by the United States Bureau of Mines. X-ray examinations revealed the wide-spread prevalence of silicosis and tuberculosis among the miners, many of whom had worked in the dusty mines of the old Joplin District. The outcome of this study was a cooperative agreement reached in the early spring of 1927, between the Bureau of Mines, the Metropolitan Life Insurance Company, and the Tri-State Zinc and Lead Ore Producers Association, for the establishment of a well-equipped clinic at Picher, for the

* Safety Director, Commerce Mining & Royalty Company, Miami, Okla.

Shown in the picture at the top of the page are:

Front Row, Left to Right: Riley Clark, Deputy Mine Inspector of Oklahoma; Joe Wilson, Safety Engineer, Interstate Zinc & Lead Co.; Jeff Plummer, Safety Engineer, Evans Wallower Lead Co.; Claude Raymond, Safety Engineer, Cortez-King Brand Mines Corp.; George Herrin, Safety Engineer, Consolidated Lead & Zinc Co.; John G. Miller, Safety Engineer, Federal Mining & Smelting Co.; Fred H. Nesbitt, Safety Engineer, Tri-State Zinc & Lead Ore Producers Association.

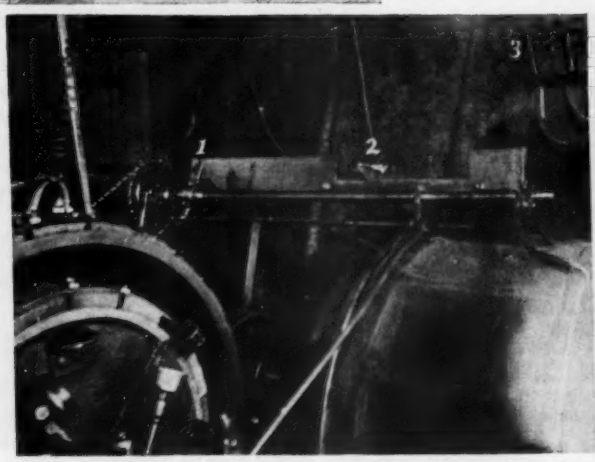
Second Row, Left to Right: O. H. Highley, Safety Engineer, New Chicago Mines Corp.; Claude Coffey, Safety Engineer, St. Louis Smelting & Refining Co.; James Lynch, Insurance Inspector, United States Fidelity & Guaranty Co.; P. M. Arthur, Safety Director, American Zinc Co., of Mascot, Tenn.; H. G. Hensel, Safety Director, Youngstown Sheet & Tube Co., Chicago, Ill.; Charles Williams, U. S. Geological Survey, Miami, Okla.; Roy Cadden, Works Accountant, Century Zinc Co., Baxter Springs, Kans.; Roy Williams, Safety Engineer, Missouri-Kansas Zinc Corp.

Third Row, Left to Right: Dr. F. V. Meriwether, Surgeon in Charge of Tri-State Cooperative Clinic; O. N. Wampler, Safety Director, Eagle-Picher Lead Co.; Henry Giessing, Safety Director, Commerce Mining & Royalty Co.; W. G. Stevens, Mining Editor, Miami News-Record; Dave K. Wier, Safety Engineer, Century Zinc Co. Back of Third Row: John Luckey, Safety Engineer, Velie Mines Corporation.

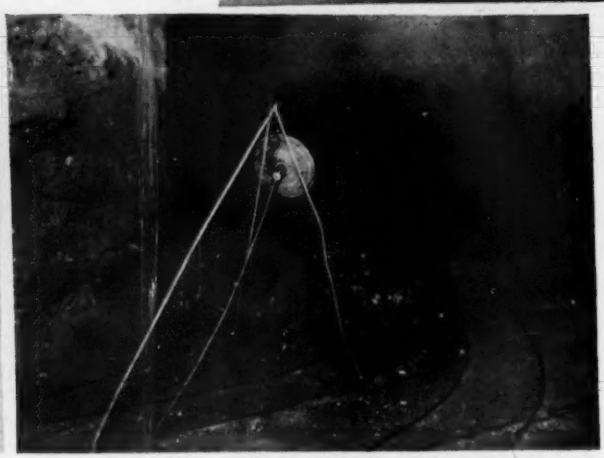
(2) *Staff of the Tri-State Cooperative Clinic, supported by joint agreement of the mining companies, Metropolitan Life Insurance Co., and U. S. Bureau of Mines. Front Row, Left to Right: O. E. Gilliland, X-ray Technician; Thelma Mitchell, typist; T. V. Willis, surgeon, V. D. Department; Frances Sims, Assistant X-ray Technician; F. V. Meriwether, Surgeon in Charge of Clinic; Marjorie Sayer, typist; Alma Maxwell, typist; W. W. Lambert, orderly. Back Row, Left to Right: J. Walter Hough, surgeon; A. J. Martin, Chief Clerk; L. E. McCanna, surgeon; G. E. Richards, Janitor*

(4) *Showing can and long bail and bonnett at the Eastern Mine of the Eastern Lead & Zinc Company. Note the bonnett on top of the bail to prevent the men being struck by falling objects while riding shaft. Hooker is wearing army type helmet generally worn by hookers and bumpers to protect their heads from objects falling down shaft*

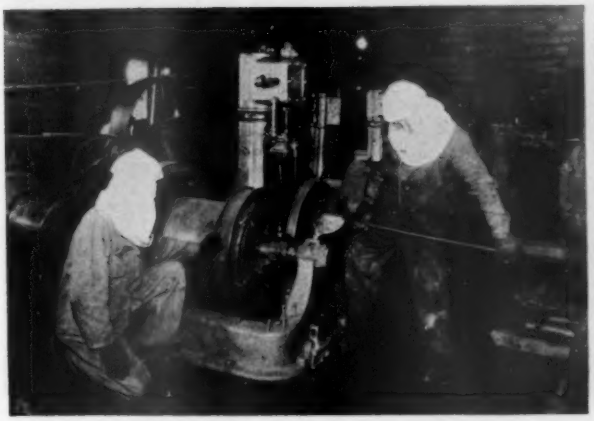
(5) *"Safety can" being tried out at Gordon Mine of Federal Mining & Smelting Company, Picher District. Several of these cans are being tried out in the district for the handling of men. The cans are tapered at the bottom to prevent bumping and the designers claim that a man can not fall out if the can bumps, he can not reach out and fight the wall while being hoisted or lowered, and that he will be protected from falling objects*



(3) *Position indicator made by hoisterman at New York Mine, Cortez-King Brand Mines Co., consisting of feed screw, bicycle sprocket wheels and chain, driven off hoister drum. Position indicator* (1) *travels along feed screw showing location of can in shaft. If engineer neglects throwing out clutch when can reaches shaft collar, the indicator* (1) *engages* (2) *shutting off power* (3) *and preventing overwinding*



(6) *Flood Light at the Beaver Mine. This is a cheap movable electric flood light used in a great many of the mines in the Picher District to light up high stopes and working places. It consists of three pieces of old pipe for a tripod, a white enamel mill reflector, a 250-watt globe and a heavy rubber insulated wire*



(7) *Machinist and helper at the Machine Shops of the Consolidated Lead & Zinc Company pouring babbitt for bearing on a hoister. Asbestos helmets are worn for protection against flying metal in case of explosion*

(8) *Drift at the Beaver Mine of the Commerce Mining & Royalty Company in the Picher District. Shoveler sledging boulder wearing goggles, other shoveler in drift turning his back for protection from flying pieces of rock*

free examination of miners and other employes and their families, and also of applicants for employment.

Since the opening of the clinic, June 1, 1927, it has become increasingly evident that it is one of the most valuable assets to the work of accident prevention. It is obvious that illness and physical disability are apt to be fruitful causes of accident. In the first seven months of the operation of the clinic, 9,803 persons, including over 400 women and children, were given complete physical examinations, and the number being examined continues at about the same rate. The safety engineers have cooperated in every way possible to induce the men and their families to make use of the clinic, and the results have been very gratifying.

Following his examination, each man is given a clinic card containing his photograph, physical rating, and instruction as to when to report for reexamination. He is given proper advice, and, in certain cases, treatment. As a result, many men have been taught to take proper care of their health, many have left the mines for open air employment, and others have been transferred to jobs more suitable to their physical condition.

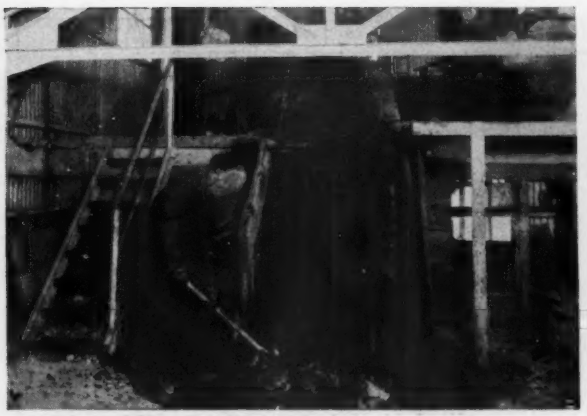
It has not been the policy of companies to discharge a man on account of low physical rating, but rather to assist him to improve his condition. An applicant for employment, however, is asked by most companies to show his clinic card, and any one with a serious infirmity or a contagious disease is not employed. This precaution is a very valuable protection not only to the company but to the employes. Most of the miners have come to realize the value of the clinic to them and do not hesitate to make use of it.

Through the advice and suggestions of the clinic director, ventilation in mines has been improved where necessary, and most of the dust in the mines has been eliminated. Wet drilling is practiced without exception, and all mine bottoms, haulage ways, and muck piles are kept saturated. The work of the clinic has greatly reduced the amount of silicosis and tuberculosis and other diseases among the miners, and certainly has helped to decrease the number of accidents and to increase the efficiency of the men. Dr. F. V. Meriwether, surgeon of the United States Bureau of Mines, is in charge of the clinic, the entire staff of which is shown in a photograph (No. 2) on the preceding page.

In addition to safety devices and safe practices which have been inaugurated, and the safety educational work done among the miners, the general environmental conditions around the mines have been greatly improved. The installation of change houses and bath houses has encouraged most of the miners to take a bath and change clothes before going home after work. This is particularly important in winter when the tendency to ride home with wet clothes on in open cars is very dangerous to health. Better housekeeping both underground and on the surface undoubtedly has helped to reduce accidents. At many mines the debris and rubbish which formerly cluttered the property is kept cleaned up, and the employe coming to work each day is greeted instead by a beautiful garden of flowers. Each year prizes are awarded for the best flower gardens in the district.

Hoisting has received much consideration from the safety engineer's organization. The standard method of hoisting ore in this district is by tubs or cans. Those now in use, commonly called 1,650-lb. cans, are 32 in. deep and 32 in. in diameter. The majority of the hoists, driven by electric motors of from 50 to 125 hp., have in addition to the usual brakes, auxiliary or safety brakes, thus providing double the usual braking power. A few hoists are equipped with position indicators which serve also to disconnect the power, and thus prevent serious damage, in case of over-winding. Photograph No. 3 shows the position indicator installed on a hoist. The West Side Mine of the Commerce Mining and Royalty Company is equipped with a Lily hoist-control, common to cage and skip hoisting but the only one installed on our type of hoist. It is set for a maximum speed of 500 ft. per minute when handling men, as is provided by the Oklahoma Mining Code. It does not interfere with the usual hoisting operations and has always proved very satisfactory. At a few of the mines, a standard can has been equipped with an extended bail covered with a sheet steel bonnet for use in inspecting and trimming down-cast shafts in winter when ice has accumulated. Photograph No. 4 shows one of these cans. Very recently an enclosed steel can for handling men only was installed at the Grace Walker Mine. This can is covered on top, is over 6 ft. high, is 38 in. in diameter, and weighs 540 pounds. By making the sides of perforated metal, the weight can be materially reduced without decreasing the safety. Such a can is like a cage, completely enclosing and protecting the men. Photograph No. 5 shows this safety can. The tub hooker at the bottom of the shaft and the bumper who pushes the cans up to the shaft for hoisting are required to wear steel helmets of the army type for protection against falling objects. Many lives have been saved by this practice.

Through the suggestions of the safety engineers and the mine inspectors, illumination in the mines has been much improved. Experience shows that there are fewer accidents in well-lighted mines. Our company, as well as many others,



(9) *Workman in Screen Room of Blue Goose Mine sledging boulders and wearing a safety face mask. This mask is attached to a 2-in. leather head band by a flat-head short bolt with a butterfly nut, making it adjustable so that the screen can be raised up out of the way when the workman is not exposed to hazards of flying objects. Note protection to throat as well as face. In photograph No. 10, on the right, the man is shown with the screen raised*

now furnishes each ground foreman a powerful electric flashlight which is used to examine high roofs and walls for fractures and loose rocks. Roof trimmers also use these lights to make their inspections. When necessary to do very high work, a spot light is set up to light the entire area where the men are working. Working faces in the mines vary from 8 ft. to 80 ft. in height. At the high faces especially, a great many accidents which might result in injury to the leg and foot are eliminated by proper lighting. Loose boulders can be more easily detected and stopes can be kept more free from rolling rocks. Photograph No. 6 shows a 200 or 300-watt lamp with a large reflector mounted on a tripod and directed at the stope and heading.

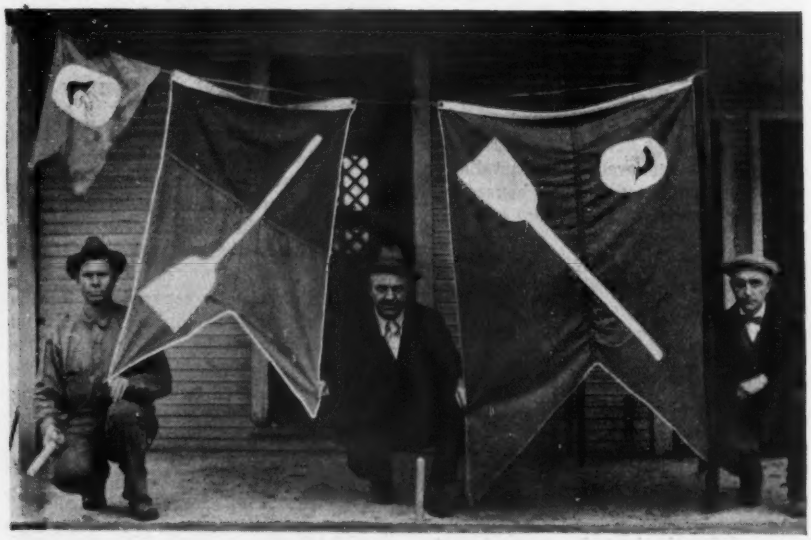
The use of a carbide dispenser not only prevents waste of carbide, but prevents cuts on hands and arms which might be caused by reaching into the original container, and also prevents explosions and burns which might be caused by spilling water into the carbide.

Accidents to eyes have been reduced by the use of screen goggles. Machinemen and helpers are furnished goggles to be used when starting and blowing holes, and shovelers are furnished them to be worn when sledging boulders. Where goggles have been used by employes of our company, we have not had a serious eye injury in four years.

Photograph No. 8 shows a shoveler sledging with goggles on, and another with his back turned to avoid injury. Cull-men working on the screens are required to wear masks of heavy steel wire for the protection of face, neck, and eyes. These have an adjustable head band, and are hinged so they can be raised without removing. Photograph No. 9 shows this mask lowered for use, and Photograph No. 10 shows it in the raised position. Mill-men are instructed to use goggles or helmets as shown in Photograph No. 7 while pouring hot metal, thus avoiding burns on the face and possible injury or loss of eyes.

Among other safety devices in wide use are shot protector tubes for the prevention of premature explosions. We have no record of any injury due to premature explosions where these tubes have been used. In our concentrating plants we require that all movable machinery be guarded. Speaking tubes from underground to the hoist room have been installed in practically every Oklahoma mine in the district, and some of the mines have telephone communication. First-aid training by the Bureau of Mines has been afforded at various times to miners in this district. While not nearly all the men have been so trained, we do believe that this work has been materially responsible for reducing our accident frequency.

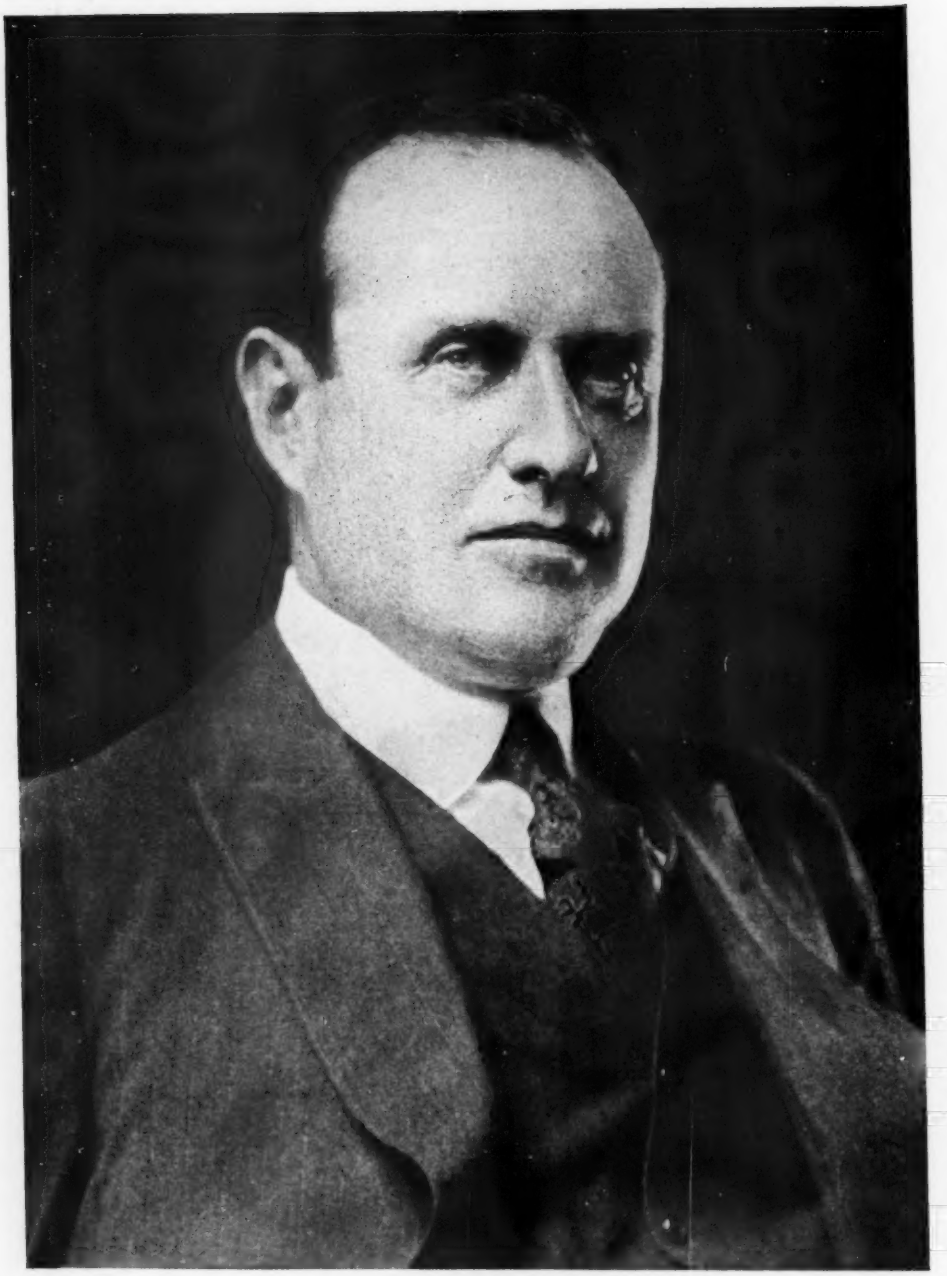
Many companies offer prizes and bonuses to employes for good monthly accident records. At present our company gives each man a pair of work gloves when the mine goes through the month without a lost time injury. Through the Ore Producers Association, flags are awarded (*Continued on page* 875)



(11) *Flags given in the Tri-State District for safety records. Picture taken at the office of the Webber Mine of the Commerce Mining & Royalty Co., Picher District. The men in picture are left to right: William Anderson, Ground Boss; Pat McLaughlin, Supt.; Henry Giessing, Safety Director, Commerce Mining & Royalty Co. The small flag is the "Pete" Flag and is given for 3,500 continuous man-shifts worked without a lost-time accident or three months without a lost-time accident. The second flag is the "New Broom" Flag, and is given to mines working 8,000 continuous man-shifts or six months without a lost-time accident. The third flag is a "Combination" Flag, and is given to mines working the entire year without a lost-time accident. This is the second flag of this type that has been awarded to the Webber Mine, they having operated the years 1927 and 1928 without a lost-time accident. McLaughlin and Anderson are also the inventors and manufacturers of the McLaughlin and Anderson Safety Shot Tubes used in all the mines of the Commerce Mining & Royalty Company, and many other mines of the Tri-State District*

© Ernest L. Crandall

The Washington Monument as seen through the pillars of Memorial Continental Hall



A. E. BENDELARI

President of The Eagle-Picher Lead Company.

EAGLE-PICHER—a Large Factor in the LEAD INDUSTRY

While lead was discovered in Joplin District in 1851, present industry there dates from 1870—The Eagle-Picher Lead Company a factor in this field since 1874—Scope and breadth of industry and company's activities outlined

By A. E. BENDELARI *

THE first discovery of lead near the city of Joplin was made in 1849, by David Campbell. It was discovered at a point about 1 mile northwest of the site of the present Eagle-Picher plant on the farm of John C. Cox. This ore was a lead carbonate. The first discovery in this particular city of the sulphide ore or galena was made by a slave boy owned by John C. Cox, while digging for fishing worms, in 1851.

Lead mining and smelting were carried on in a desultory way with a smelter on Swindle Hill about 1½ miles south and east of the present Eagle-Picher plant. The Civil War stopped these developments.

The modern Joplin field dates from 1870, when Moffet and Sergeant established the plant which later passed into the hands of the Eagle-Picher Lead Company.

In 1871, approximately a million and three-quarters pounds of lead was mined in Joplin. By 1876, 17 small lead smelters were in operation at Joplin, and the annual tonnage of lead and zinc ore amounted to more than 30,000,000 pounds.

The Eagle-Picher Lead Company dates back in the Joplin field to 1874, when Judge Oliver H. Picher and W. H. Picher, his brother, entered upon the smelting business. Later Picher Brothers took over the Moffet and Sergeant plant which is now the Eagle-Picher plant in Joplin.

Judge Picher and later his son, Oliver S. Picher, guided the destinies of the Picher Lead Company at Joplin, until the merging of the two companies in 1916, from which date the present Eagle-Picher Company has operated at Joplin. It is significant to note that sublimed white lead, sublimed blue lead, and sublimed litharge were all developed at the Joplin plant.

The company expanded into the Galena field at Galena, Kans., in 1912, when the Picher Lead Company purchased the lead smelter now operated there. This plant was constructed in 1902.

Whether it was because of the lack of some such influence as that of the pioneer preacher, Rev. Joplin, who gave the town of Joplin its name, Galena has recorded a much more eventful history than has Joplin. Lead ore in paying quantities was first discovered within what is now the city limits of Galena, but it was a year later before a discovery was made of such consequence that a lead rush was started. It is estimated that 10,000 people came to the territory within 30 days after this discovery.

The Picher Lead Company entered the field to which it has given the name of Picher in 1913. Mr. Oliver S. Picher extended the operations of the company in the Oklahoma field northeast of Commerce where the Eagle-Picher mines are now located. The drilling development of this field was done under the supervision of George F. Braun. The first year's work was not particularly encouraging and the first discovery of ore in paying quantities was the result of a wildcat drill hole in October, 1914.

In March, 1915, under the direction of A. E. Bendelari, five shafts were started and the actual work of developing the properties was started. In June, 1915, George W. Potter joined the mining division of the company.

On that part of the field now covered by the Crawfish mine, the White Bird, Bingham, and Netta mines were discovered before the end of the year. Many shafts, at the present time, have been completed on the operating properties of the company.

Not to be outdone by the pioneer's stories of Joplin and Galena, Picher, though developed well into the twentieth century, has a romance of its own. Sinking of the shafts was a constant battle against water, and at times this water was sulphuretted to such an extent that it affected the eyes of

JOHN B. SWIFT

Chairman of the Board, The Eagle-Picher Lead Company

* President of The Eagle-Picher Lead Company.

Dr. J. A. Schaeffer, Vice President of The Eagle-Picher Lead Company, in charge of manufacturing

the workers so that they could not work in longer periods than one hour on duty and one hour off. Transportation also was very bad, and a plank road was laid down from the Oklahoma-Kansas state line to the mine, and the boilers and material brought in over it. The machinery for the mill was brought in from Quapaw. By August, 1916, four large mills or concentrating plants were in operation at Picher.

To write the full history of the development of this field would be to write again the gripping tale of the advance of the American frontier across the territory that eventually became and is today the United States.

E. B. Overbeck, Treasurer of The Eagle-Picser Lead Company

History of the Eagle-Picher Lead Company

On June 1, 1916, the Eagle Lead Company, of Cincinnati, and the Picher Lead Company, of Joplin, Mo., were merged, and since that time these two companies have gone forward as the Eagle-Picher Lead Company.

Under the direction of able leaders, the Eagle-Picher Lead Company has become one of the foremost manufacturers of oxides, sublimed white lead, white lead in oil, and plumbers' lead goods. This company has also been active in the development of the lead ore fields in Missouri and Oklahoma, now owning or controlling a large number of mines in this section.

The brand of Eagle white lead in oil was established in 1843. The Eagle Lead Company, of Cincinnati, was then owned by Wood & Sons. In addition to white lead in oil, they manufactured colors and putty. Their maximum tonnage on white lead in oil, produced by the Old Dutch process, was approximately 600 tons a year. Today the Eagle-Picher Lead Company operates 11 manufacturing plants and has offices and warehouses in principal cities throughout the United States. In addition to lead and zinc products, the company is also interested in oil and gas production in Oklahoma.

The Company's Plants

The Eagle-Picher Lead Company's operations in East St. Louis include a white lead in oil plant and an oxide plant that embodies the latest mechanical equipment. East St. Louis offers many advantages for a plant of this nature. Besides being located near the lead mining district, it has excellent transportation facilities.

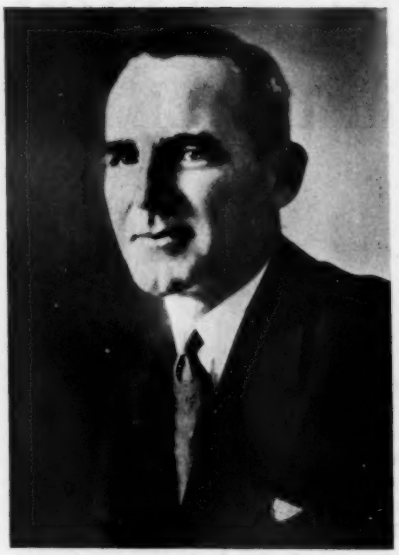
The Joplin plant is the parent of the Picher or dry products end of the Eagle-Picher business. Here is manufactured sublimed white lead, red lead, litharge, sublimed litharge, and orange mineral.

The research department, with its laboratories, the various equipment—blast furnace, scotch hearth, and the slag-eye—producing pig lead; and the metal department, are important features of the Joplin plant.

At Galena is the Galena smelter, which is a big factor in the production of pig lead and sublimed blue lead.

Operations in and around Picher include the mining of lead and zinc ore and the milling of it. After the separation of the ore in the milling department into lead ore and zinc ore, the zinc is shipped to the Eagle-Picher lead smelters in Henryetta, Okla., and Hillsboro, Ill. The lead ore goes to Galena, Kans., and Joplin, Mo., to be smelted.

The Hillsboro plants include a zinc oxide unit, a zinc smelter, and sulphuric acid plant.



George W. Potter, Vice President of The Eagle-Picher Lead Company, in charge of mines and smelters

The Importance of Eagle-Picher Products

Eagle-Picher products are important in the dry lead pigment field. Many products which find their way into the average home—chinaware, enameled tile, brick, pottery, shade cloth—have had red lead play a part in their manufacture. Glassware, linoleum, and safety matches may also be added to this list. Litharge and other lead pigment is needed in the manufacture of many articles with which the average person is familiar. Oil refineries need it, rubber manufacturers consume quantities of it, and the storage-battery industry uses great amounts

Joseph Hummel, Jr., Secretary of The Eagle-Picher Lead Company

R. M. Roosevelt, Vice President of The Eagle-Picher Lead Company, at New York

of it. Litharge is also used in electric-light bulbs, in cut glassware, and in various insecticides with which the public fights such pests as ants and mosquitoes.

In the plumbing fie'd, the Eagle-Picher line is large. Lead pipe, traps and bends, roof flanges, solder, and many types of lead fittings bear the Eagle trade-mark and are used as standard equipment by master plumbers throughout the country.

The industrial field uses Eagle metal goods. Lead wool, an Eagle-Picher product, helps the oil companies wage a successful fight against an enemy of efficiency—bottom water. This Eagle lead wool is pounded in cartridge form into the bottom of the well, and leakage and waste are effectively curtailed.

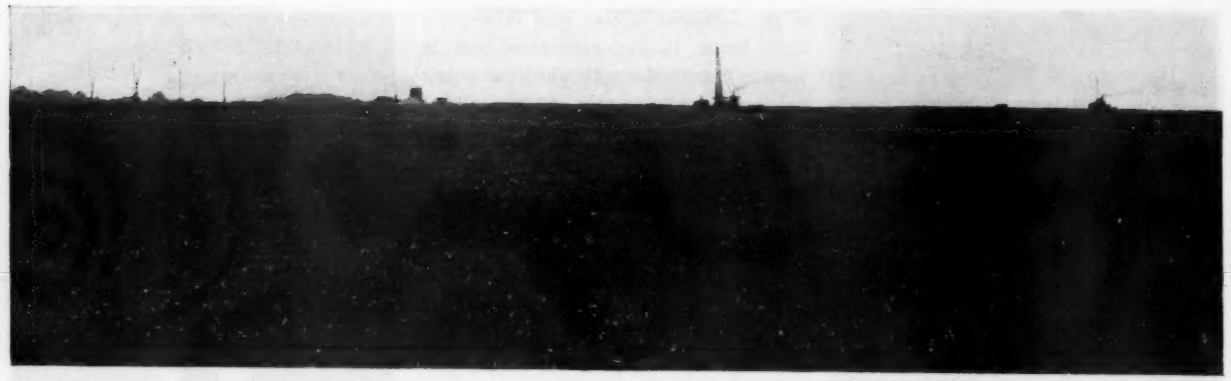
Bearing metals needed in the operation of high-speed engines, such as generators and pumps, carry the Eagle-Picher trade-mark.

Willard E. Maston, Vice President of The Eagle-Picher Lead Company, Direc- of Sales

The Eagle-Picher Lead Company plant at East St. Louis, Ill.

The Eagle-Picher Lead Company plant at Joplin, Mo.

The Eagle-Picher Lead Company at Cincinnati, Ohio



Picher, Okla., June, 1915

EXPLORATION METHODS at The Eagle-Picher Lead Company

By R. K. STROUP *

Brief sketch of geology—Ore Occurrence—Preliminary Exploration—Final Exploration and Mine Development

THE Tri-State District, in which are located the principal mining operations of the Eagle-Picher Lead Company, comprises portions of northeastern Oklahoma, southeastern Kansas, and southwestern Missouri. In general, the mineralized areas, which have been worked commercially, are contained in a section 60 miles from east to west and 40 miles from north to south, with Joplin, Mo., at its center. The towns and cities in the area have marked the scenes of the greatest mining activity. At the present time the main operations are in the western section of the field, centered around the city of Picher, Okla.; it is this part of the field to which this discussion applies.

The country is, in general, a grass-covered prairie with occasional low, flat-topped hills rising above the general level. The drainage is to the southwest by a series of streams of the Spring and Neosho River systems.

There are few surface exposures of rocks. The formations dip gently to the west. A geological cross section, as shown by a drill hole near Picher, is given in *Figure 1*.

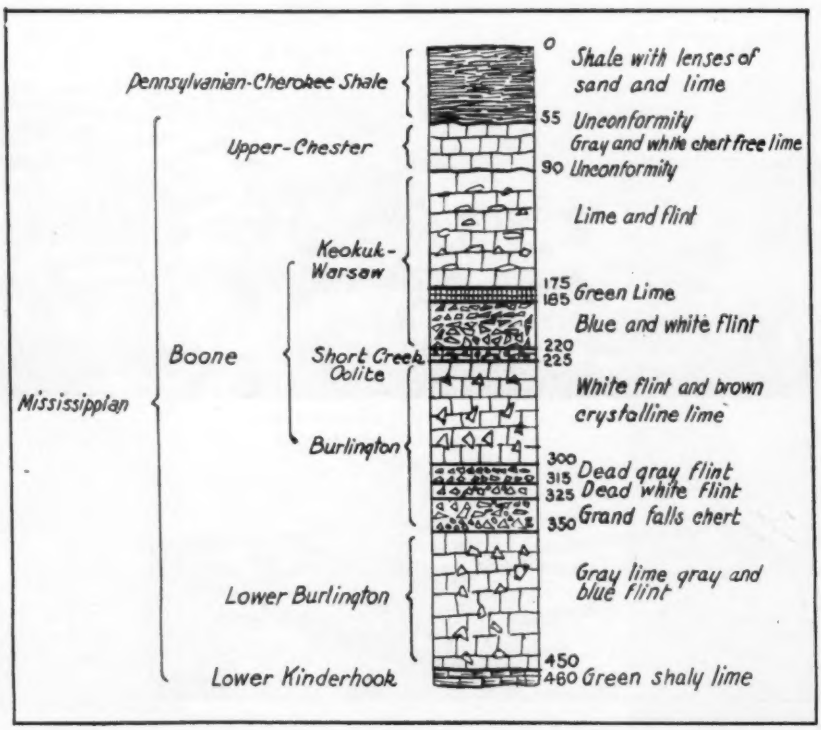


Figure 1—Geological cross-section from a drill hole near Picher, Okla.

There is, sometimes, considerable difference in the shale depths in adjacent holes, and drilling will show the shale to fill a pocket or trough in the lime. No definite relation between these and the ore bodies has been established, although considerable experimental work has been done along this line. The Short Creek oolite and the green lime are very valuable as markers.

The ores occur as sulphides of zinc and lead, and are associated with a gangue of chert, calcite, and dolomite. Iron sulphide is also pres-

* The Eagle-Picher Lead Company.

R. K. Stroup

ent in varying amounts. Ores occur disseminated through the jasperoid breccia or in sheets or lenses of solid ore. The principal working levels at Picher are approximately 200 and 270 ft. The lower is by far the richer and more continuous ore horizon. The sheet ground is being worked in an area to the northeast, but its presence in the western section has never been proved over a sufficient area to warrant mining.

Leasing

Only in a few instances do the mining companies own the land upon which they operate, but it is leased upon a royalty basis. Royalties vary from 5 to 15 percent of the gross ore sales, depending upon the location and the developments upon it or surrounding properties at the time the lease was acquired. A sliding scale of royalty based upon ore prices is in use in some cases and it has proved very satisfactory to both parties. The restricted Indian lands, which comprise a large portion of the Oklahoma side of the field, are held under leases by the Department of the Interior.

The usual procedure in taking a tract of land is to execute a contract for a mining lease. This contract gives the mining company a right to enter upon the land and carry on prospecting operations. If, within the specified time, commercial ore bodies are found, a lease is drawn up of the same form as the specimen copy, which was attached to the contract. If no ore is found and the property is to be turned back, a written release from the contract is secured from the land owner. The advantage of this system is that the property is not tied up for a long period and the title is not confused.

The terms of the contract call for prospecting operations to start within a certain time, and to be carried on continuously; unless the land owner gives written consent to suspend work. He may in the contract specify the number of holes to be drilled within a certain time, or the number of rigs to be kept in operation. These matters are, however, more often left up to the discretion of the mining company; and, unless otherwise specified, one rig working single shift is sufficient to hold a lease. Contracts often reserve certain areas and name the basis for settlement of crop and property damage.

A bonus is sometimes paid for a tract of land which is favorably located adjoining producing properties, or properties which have drilling or workings upon them that would better their chances of developing into mines more than that of an entirely unproven acreage. This bonus may be paid when the contract is made, or it may be made in installments as the prospecting work progresses. Advance royalty payments are sometimes made. Bonuses vary from a few hundred to several thousand dollars.

Sometimes it is customary to lease a large block of land as a unit for "wildcat" drilling. Each land owner has a separate contract, and in event ore is found will have a separate lease, yet the mining company has a right to move from one land to another as they see fit. These contracts are binding upon all as long as operations are being carried in the specified sections. Such contracts have a definite time limit, usually for two or three years.

Surface Drilling

The churn drill is used for surface prospecting in this district, as the crevices and openings in the formations make it impractical to use the rotary machines. Practically all the various makes are found. Rigs are all of the unit type, driven by gasoline engines. Tractor or truck motors with regular clutch and transmission are the favorite. Housings are placed over the motor and belt, which will enable them to operate under any weather conditions. Rigs propel themselves when moving from one location to another; and are frequently moved long distances on the road under their own power. Their road speed is from 3 to 4 miles per hour. A standard string of tools with 6¼-in. bit, 26-ft. stem, jars, and rope socket weigh about 2,100 pounds.

Holes of ordinary depth are started and finished with a 6¼-in. bit; but if the ground becomes loose and cavy it is necessary to put in casing and continue with a 4¼-in. hole. If it is known beforehand that bad ground is likely to be encountered, a larger hole will be started so that more reductions in size can be made.

After the hole is through the shale, samples from each 5-ft. run are kept. These are piled out in a row upon the ground and are tagged. When ore is encountered, or when there is a likelihood that the hole is near the ore, 2½-ft. runs are made. This procedure is followed until the hole is well past the ore. The 2½-ft. samples are allowed to settle in a tub, and when the water clears up it is then drained off and the sample taken. A common practice is to place all the entire contents of a bailer in a hole dug in the ground and allow the water to seep away; or to place the sample in a closely woven sack and let the water drain off. When these samples are sufficiently dried they are mixed and cut down until those of suitable size for assay are secured. Assays are all reported as sulphides. Iron determinations may be made if it is thought necessary, for a high iron content will greatly reduce the value of the zinc concentrates.

DRILL RECORD

Hole No. 69

Total Depth 292

A. E. BENDELARI, Agent

Property Name (if any) Whitebird Drill Owner A. S. Baldry

Begun 2/20/28 Finished 3/3/28 Water Level 270

Drill Runner (day) Matt Lane (night)

DEPTH From	DEPTH To	FORMATION DRILLED THROUGH	REMARKS
0	70	Clay and shale.	
70	130	Gray lime.	
130	160	Gray flint.	
160	210	Gray flint and gray lime.	
210	215	Gray flint, few jack and lead shines.	
215	245	Gray, shelly flint.	
245	257½	Gray flint, jasperoid, good jack.	
257½	262½	Gray flint.	
262½	265	Gray flint, some jasperoid, jack traces.	
265	290	Gray and brown flint.	
290	292	Dark gray flint, gray lime.	

ASSAY:

Depths	Blende.
245-250	6.75
250-252½	2.65
252½-255	8.05
255-257½	4.25

Signature

Land Description

Location of Hole

Figure 2

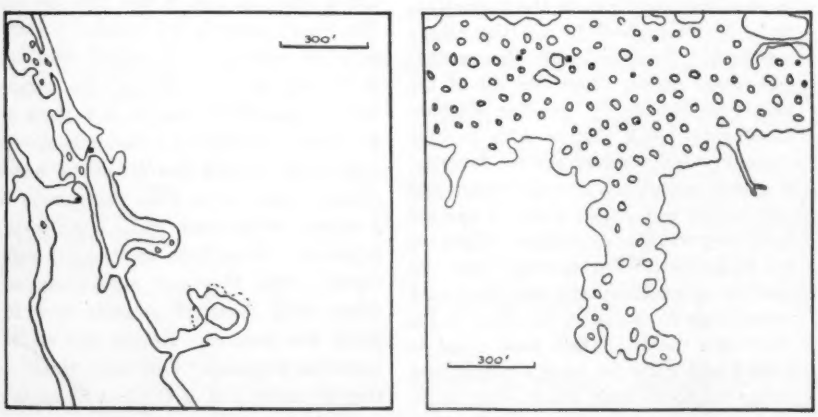


Figure 3—Maps showing different character of ore bodies encountered in the Picher Field

The drillers keep a log of the hole, and the field man makes his record from the sample piles. Records are kept upon a standard form as shown. Water flow, openings, depth of marker formations, and other peculiarities are particularly noted.

No trouble has been found with the holes salting themselves when the ore occurs in a hard, tight ground. In soft ground and under strong water the ore is apt to be loosened from the sides of the hole and it follows the drill down, so it is necessary to keep the casing close to the bottom of the hole in order to secure a representative sample. Mining in the present ore bodies, which were drilled under strong water, has shown a mill recovery slightly higher than was computed from the drilling. This is due to a portion of the fines floating away while the hard gangue material was being broken. Where the ore occurs in soft ground, or lies in selvage seams in flint, the reverse condition exists; i. e., the portion of the gangue material washed away will be greater than that of the ore, leaving an enriched sample. Holes are sometimes shot with a light charge of powder suspended at the ore horizon. Larger pieces can be secured which gives a better idea of the formations. Assays from such samples, however, are seldom representative. Holes are checked for depth at some point in or near the ore horizon with a steel tape. When finished they are measured out in a like manner; this measurement being the basis for payment.

Drilling is done by the contract; the usual price for ordinary holes being $1 per foot. In sections where more difficulty is encountered, the price may be $1.50 per foot, but it is seldom more. The contractor furnishes everything and guarantees to deliver a hole to the required depth. This system has proved more satisfactory than company-owned rigs.

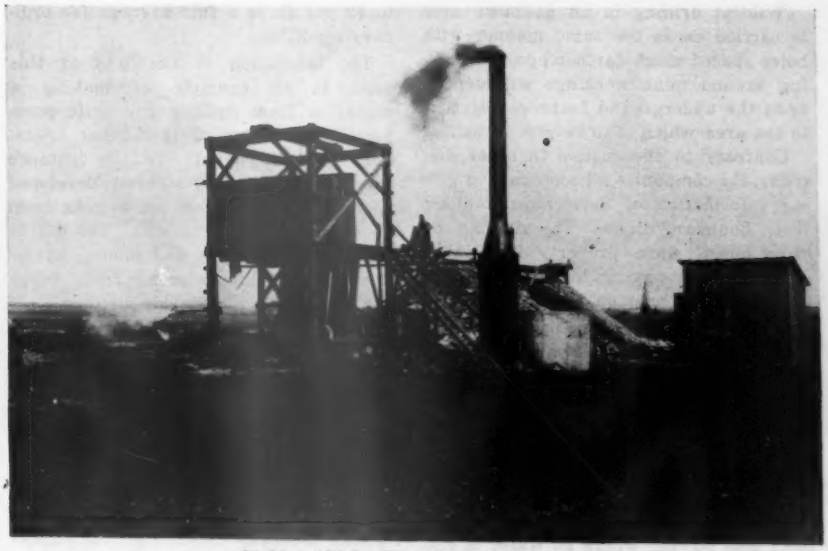
After a hole is drilled it is accurately located from land lines; and its elevation above sea level is determined. Working maps on a tract which has any promise of becoming a mine are on a scale of 1 in. equal to 50 ft. The hole is shown by a small circle with its number; and, in small lettering above, its elevation. The mine maps show sea-level elevations of roof and floor at various intervals so the depth at which the hole will be cut may rapidly be computed. Wildcat holes are located by stadia and plotted on smaller scale maps, 1 in. equal to 100 ft. or 200 ft., depending upon the size of the area to be covered.

The drill record in *Figure 2* is a log of an ore hole showing the form in which records are kept and typical formations encountered.

Developing a Tract

The number and spacing of the holes upon a tract of land will depend upon the nature of the ore bodies which are expected to be encountered. Many runs in operating mines which have proved very profitable have been less than 25 ft. wide, lying between walls which were absolutely barren. To trace out such a deposit will necessarily take much more drilling than a blanket or sheet ground area. It is not uncommon to find a hundred and fifty holes on a 40-acre tract which only give enough encouragement to continue drilling; while, on the other hand, a dozen holes have often proved a very profitable mill site.

If from adjoining properties or other drilling an idea can be secured of the general direction of the fractures, bars, and water courses on a tract of land, then the customary method would be to space a line of holes across the central part of the acreage, at about 300-ft. intervals, and in such a direction as to cut across the supposed trend of the underground features at about right angles. If this line of holes prove the theory to be correct, but none of them encounter ore, then the most favorable-looking ones for formation are picked out and holes drilled between them. These holes may be on the same line or above or below, forming the points of an isosceles triangle. The procedure may be repeated across other parts of the tract. The drilling is concentrated in the more favorably looking areas until a strike hole is found, or that section is abandoned. In the event of an ore hole, the holes are spaced around it to determine the direction and extent of the ore body. Holes are first spaced close together and widened out as the general trend becomes better known. Then side holes may be drilled to determine the width.

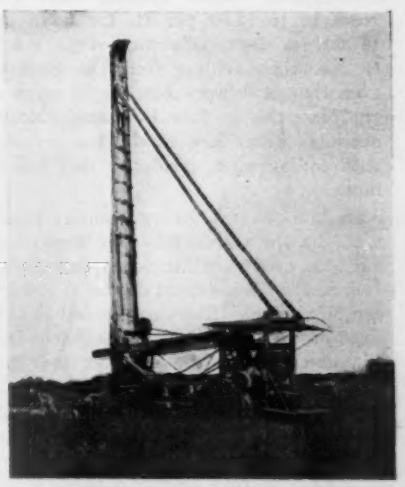


Sinking "Picker No. 1" Shaft, June, 1915

Sinking "Picker No. 86" Shaft, June, 1929

Churn drill working on side of tailing pile

Underground churn drill



Churn drill on wildcat work

Wildcat drilling in an unknown area is carried on in the same manner with holes spaced much farther apart. Drilling around mine workings will depend upon the underground features adjacent to the area which is to be prospected.

Contrary to the custom in other districts, the companies all cooperate in giving information of developments along their boundary lines. The drilling of "line holes" upon property lines with each operator paying his share of the cost is a very common practice.

Even after a number of good holes have been drilled, it is often advisable to sink a shaft and cut drifts to some of the holes before mill building plans progress too far. This cost of shaft sinking in this district does not make this practice prohibitive. A 5 x 7 shaft may be contracted for $9 per ft. in the shale and $16 per ft. in the hard rock for labor and powder where no water is encountered. The cost of a 270-ft. shaft will be about $4,800. Prospect drifting costs about $8.50 per ft. with the company furnishing all equipment. If mining operations are to be carried on later, this shaft will be used for a hoisting shaft, and the drifting will be of value in opening up the ground.

Underground Prospecting Methods

Prospecting in operating mines divides itself into two types: First, cutting of drifts, raises, and winzes; and, second, drilling with underground churn drills, or with wall drills. The first type is of great value in a district where the runs are narrow and hard to locate from the surface. Drilling in the bottom with a churn drill, developed by the Keystone Driller Company, has often proved good ore in the stope and the existence of lower deposits. Much of the earlier drilling did not extend to great depth, due to the heavy water. An underground churn drill rig will work in 18 ft. of head room. While drilling costs are from $2 to $2.50 per ft. for holes up to 60 ft. deep, this method is much cheaper than drilling from the surface, even though it were possible to move a rig onto the surface locations. Many desirable areas are now often covered with tailing piles, ponds, or mill buildings.

In late years a heavy hammer drill, made by the Gardner-Denver Company, has been used in drilling deep wall holes. Jointed steel is used and depths of 150 ft. can be reached. Holes are drilled in the sides or ends of drifts at a sufficient inclination so that the cuttings may be washed out and samples secured. Such a method is very satisfactory in picking up parallel runs and drilling into places which are inaccessible from the surface. Drilling costs vary greatly with depth of holes and character of formations; $1.50 to $2 per ft. is a fair average for ordinary conditions.

The tabulation at the foot of this page is an example of making a valuation from drilling and drift prospecting to determine if further operations are warranted. In the instance used an ore body has been developed upon a working lease, but remote from the other mining operations. The mill is already in operation and mining equipment can be transferred from other workings. It is advisable to open this particular ore body with a new shaft and haul the ore over the surface to the mill.

The necessary main items of expense to mine this ore body are as follows:

Field hopper and derrick	$2,750
Hoist and equipment	3,195
Transformers and equipment	2,025
Dog house	500
Air and water lines	750
Surface tramway	2,200
	$11,420

Mining and surface haulage equipment are not included in the estimate below, for they are to be transferred from other portions of the mine.

$14,550	expenses to date.
11,420	expenses to start operations.
$25,970	total.
105,334	profit above mining expenses.
25,970	prospecting and equipment.
$79,364	

The ore body as of that date would show a profit of $79,364. Drilling which was in progress at the time that this estimate was made would very likely extend to the limits of the ore body. With all factors, except drilling, remaining nearly a constant, the expected profits will increase in proportion to rock tonnage and richness of the ore. The factors used in this example are based upon the company's experience in mining and milling 11,000,000 tons of ore in this district.

Block A

Hole No.	Depths	Face	Pct. ZnS	Pct. PbS.	Total pct.	Ft. % ZnS.	Ft. % PbS.	Total ft. %
82C	307½-315	7½	5.25	....	5.25	39.37	....	39.37
79C	310 -325	15	4.73	....	4.73	69.55	....	69.55
78C	310 -320	10	6.91	0.18	7.09	69.10	1.80	70.90
77C	322½-330	7½	6.36	0.64	7.00	47.70	4.80	52.50
48C	323 -328	5	3.25	....	3.25	16.25	....	16.25
46C	315 -325	10	4.52	....	4.52	45.20	....	45.20
43C	315 -330	15	3.00	0.50	3.50	45.00	7.50	52.50
41C	315 -325	10	4.00	....	4.00	40.00	....	40.00
39C	325 -335	10	1.34	6.11	7.45	13.40	61.10	74.50
36C	320 -330	10	4.66	....	4.66	46.60	....	46.60
33C	310 -315	15	8.11	....	8.11	121.65	....	121.65
16C	290 -330	40	5.87	....	5.87	234.80	....	234.80
24C	320 -330	10	1.00	....	1.00	10.00	....	* 10.00
Shaft	320 -330	10	7.00	0.50	6.50	70.00	5.00	* 75.00
East drift	323 -330	7	7.00	0.25	7.25	49.00	1.75	* 50.75
West drift	322 -330	8	7.00	....	7.00	56.00	....	* 56.00
Total		190				973.62	81.95	1055.57
Average		11.9	5.12	0.43	5.55			

* Estimated.

Area, 233, 760 sq. ft.

$\frac{233,760 \times 11.9}{12.5}$ equals 222,540 gross rock tons.

Less 10 percent..... 22,254 pillar factor.

199,286 net rock tons.

199,286 × 5.12 percent equals 10,203 tons zinc concentrates.
$44.00 × 10,203 equals $448,932 gross value zinc concentrates.
199,286 × 0.43 percent equals 857 tons lead concentrates.
$90.00 × 857 equals $77,130 gross value lead concentrates.

$448,932	value zinc concentrates.
77,130	value lead concentrates.
$526,062	total value of concentrates.
42,085	less 8 percent royalty.
$483,977	
378,643	less mining and milling expenses, 199,286 tons at $1.90 per ton.
$105,334	profit above mining expenses.

Expenses to date:

8,150 ft. of drilling	$8,150.00
330 ft. shaft	5,200.00
110 ft. drifts	1,200.00
	$14,550.00

V 15 11 1 NOV

SURFACE PLANT at a Typical Operation of The Eagle-Picher Lead Company

Details of design and type of construction only distinguishing factor in surface equipment in Tri-State District—Hoisting methods, while apparently crude, result in very low operating and maintenance costs—Description of equipment and methods of production

By S. S. CLARKE *

THE description of the surface buildings and equipment of any particular mine in the Tri-State district would apply to nearly every mine here, as the general scheme is the same, the only difference being in details of design and type of construction. The view above shows a mill and incline train leading to the mill hopper and the general arrangements of the auxiliary buildings. *Figure* 5 shows a plan of the same. The first thing that visitors from other mining districts notice here is the size of the mineralized area and the enormous number of concentrators and shafts. The next thing that attracts their attention is our method of hoisting, which at the first glance appears to be very crude and inefficient, but investigation shows that the operating and maintenance costs per ton are low and the capital invested is much less than in other mining districts. The salvage value of the hoisting equipment is high, for when an ore body on a small lease is depleted it is possible to move the derrick and hopper to another lease and erect at a cost of about 50 percent of the cost of a new derrick and hopper. One engineer from Butte, Mont., said: "The Tri-State District uses a telephone pole for a head frame and a dinner bucket for a cage." No doubt it looks that way when compared to the large head frames and skips of other districts.

About 90 percent of the hoists in use are electric driven, generally powered with a 112-hp., 25-cycle, 220-volt motor. The hoists are friction pull and are geared for a rope speed of 1,600 to 2,000 ft. per minute. Some few first-motion hoists are still in use, and are nearly always used on a shaft sinking job. Some operators run them on steam, others use air. One gas engine hoist is now in operation in this district, but no data is available as to its performance.

Only three or four mines are equipped with skips, the balance using cans or buckets of either 1,200 or 1,600 lbs. capacity. These cans are 30 in. x 32 in. or 32 in x 32 in. in size and made of 10-gauge steel for the sides and 8-gauge for the bottom. The bails are 1½ in. round;

* The Eagle-Picher Lead Co.

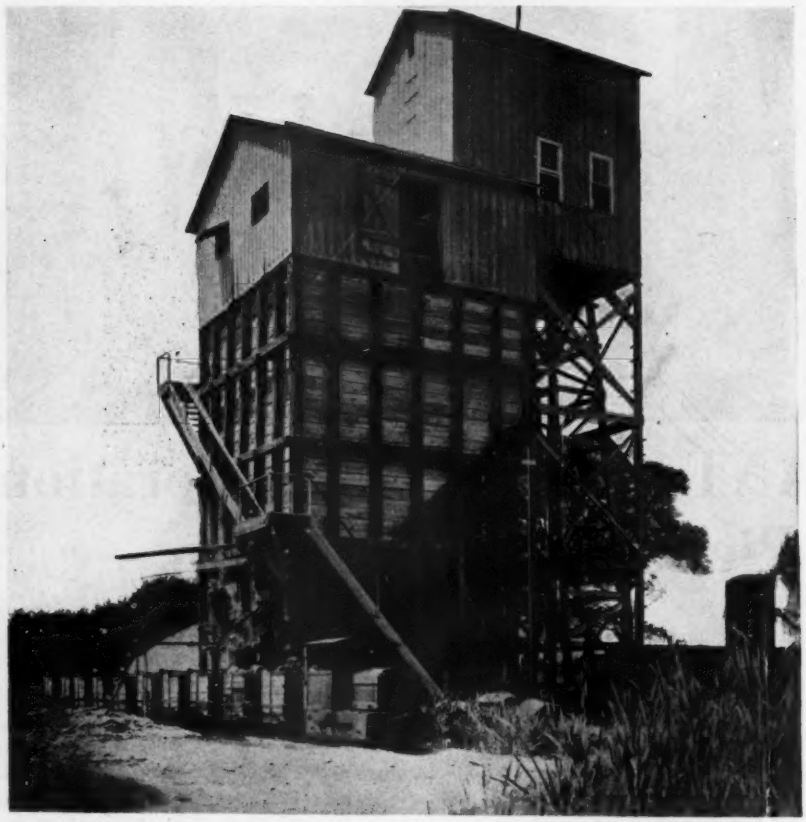


Figure 2—Storage hopper and hoisting derrick

the rim band and bail straps are ⅝ in. x 3 in. mild steel.

At mill shafts the hoist is set in the derrick about 60 ft. above the shaft collar and 5 ft. back from the center of the shaft. Such an installation is not indicative to long cable life owing to the nearly vertical down pull, but it places the hoisterman at the edge of the mill storage hopper, or bin, and he dumps the cans into the hopper by means of a tail hook which hooks in a ring in the bottom of the can.

Two men constitute the actual hoisting crew, the hoisterman and the "hooker," whose duty it is to unhook the empty can and hook on the loaded can. No signals are used while hoisting except in the case of an emergency, as the work of these men is so closely coordinated; the hoisterman can tell by feeling the rope when the loaded can is hooked. Eight hundred cans hoisted per eight-hour shift from a shaft 260 ft. deep, plus the derrick height, is the average of most mines hoisting from one shaft, which shows how well the crew work together. In some instances the hoisterman and hooker are paid a bonus of ¾ of a cent per can on all cans over 600 per day.

The hoisting cables used are ⅝ in., 7 x 18 non-spin type and will handle approximately 40,000 tons before they are discarded. The asbestos blocks on the friction band have a life of about 16,000 tons. The sheave wheels in general use are 36 in. diameter; some are using a roller bearing sheave rotating on a fixed shaft, this type proving very satisfactory.

Nearly all of the hoisting derricks and hoppers are built of wood and some few are being built of steel. The initial cost of a steel derrick and hopper is more than that of a wooden structure, the maintenance costs are lower and the fire hazard is eliminated. No doubt at a long life mine they are much more economical, although no data is available as to the cost of salvaging one and re-setting on another lease.

The hoisting derrick is of a skeleton construction, 16 ft. square. Corner posts are 8 x 8 timbers, banded with 2 x 12 and sway braced with 2 x 8. The Samson posts or hoist supports are of 8 x 8 timbers; one pair is placed just in front

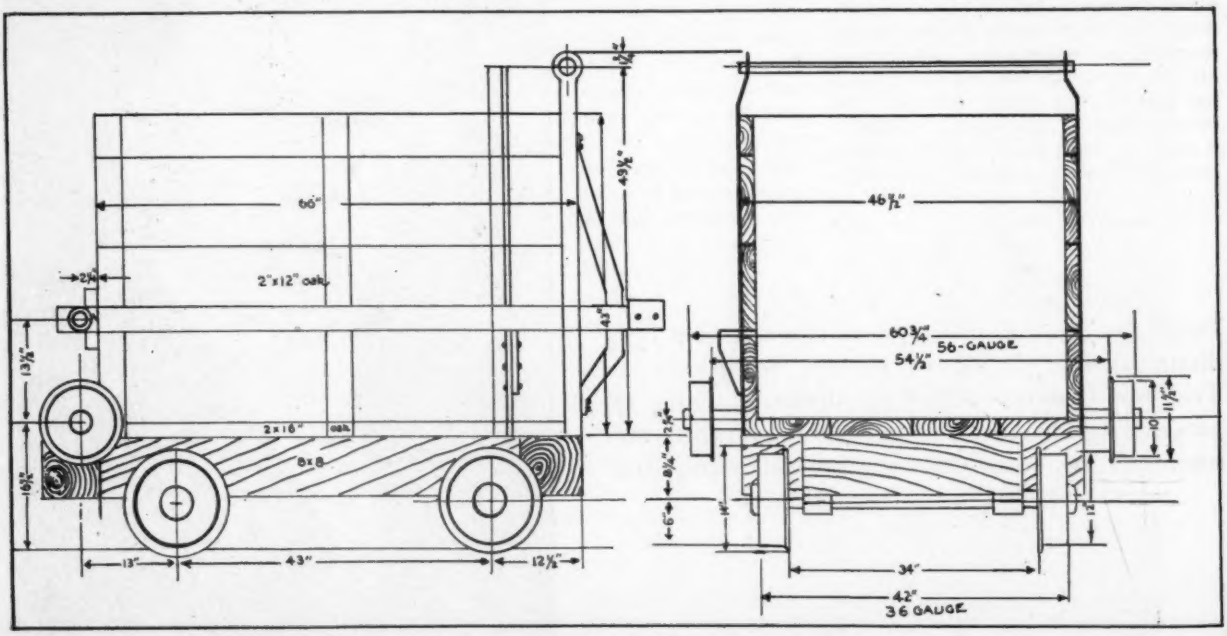


FIGURE 3

of the back derrick legs, the other pair at the edge of the shaft. These posts batter ½ in. per foot and are capped with 8 x 8 caps that carry the hoist. In addition to bolting the hoist to the caps, it is further tied down by clamping old cables from the caps to the sills and tightening with a turnbuckle. Inside the derrick legs a well hole is built to guide the can up to the dump. This prevents the can from swinging and catching on the derrick braces. The well hole is started at a sufficient height above the shaft collar to clear men and material and is started the size of the shaft and tapered down to 4 x 4 ft. at the top where the trap door is placed. This door is lowered and seals the shaft when a can is being dumped.

The field shafts are similar in design to the mill shaft except that they are built with a 40-ft. derrick. *Figure 2* illustrates a field shaft and a tram train being loaded. *Figure 4* shows the details of construction of a field derrick and hopper.

The ore, or dirt, as it is locally called, is loaded into end dump tram cars (*Figure 3* is a sketch of the wooden type tram car, the coupling is omitted, the old link and pin coupling is the style in use). These cars have a capacity of three tons, 8 to 12 cars constitute a train, depending on the grade, and is pulled by a gasoline locomotive.

The gauge of the train railroad is 36 in. and 36-lb. steel is used. The train is pulled to a lay-by, or loop, at the foot of the incline leading to the mill bin. There the cars are pulled up one at a time by means of an electric hoist powered with either a 25-or 35-hp. motor.

When the tonnage required from a field shaft does not exceed 200 tons per 8-hour shift, one man is able to handle it, including the incline hoist. Gasoline consumption will be from 5 to 10 gallons per shift; the length and grade of the tram road and the skill of the operator govern the gasoline consumption.

The incline leading to the mill hopper is of the usual 2-post trestle bent type. These bents are built of 6 x 6, spaced 16-ft. centers and battered in to 42 in. at the top; 6 x 8 stringers are used to carry the cross-ties. The bents are knee braced in to the stringers with 6 x 6's, the bents being cross-braced and tied to each other with 2 x 8's. Where the incline passes over ore bins or a roadway, it is floored with 1 x 12 and 3-ft. sides are built to prevent spillage.

The pitch of the incline is 25 degrees from the horizontal, and the dump-ways at the head of the incline are built with slope of 32½ degrees from the horizontal, which is ample for a car to clean itself. Should the mine dirt carry wet shale it is necessary to steepen the dump-way. A 48-in. sheave wheel is set at the end of the dump-way; this sheave is given a slope of ½ in. in 12 in. away from the center.

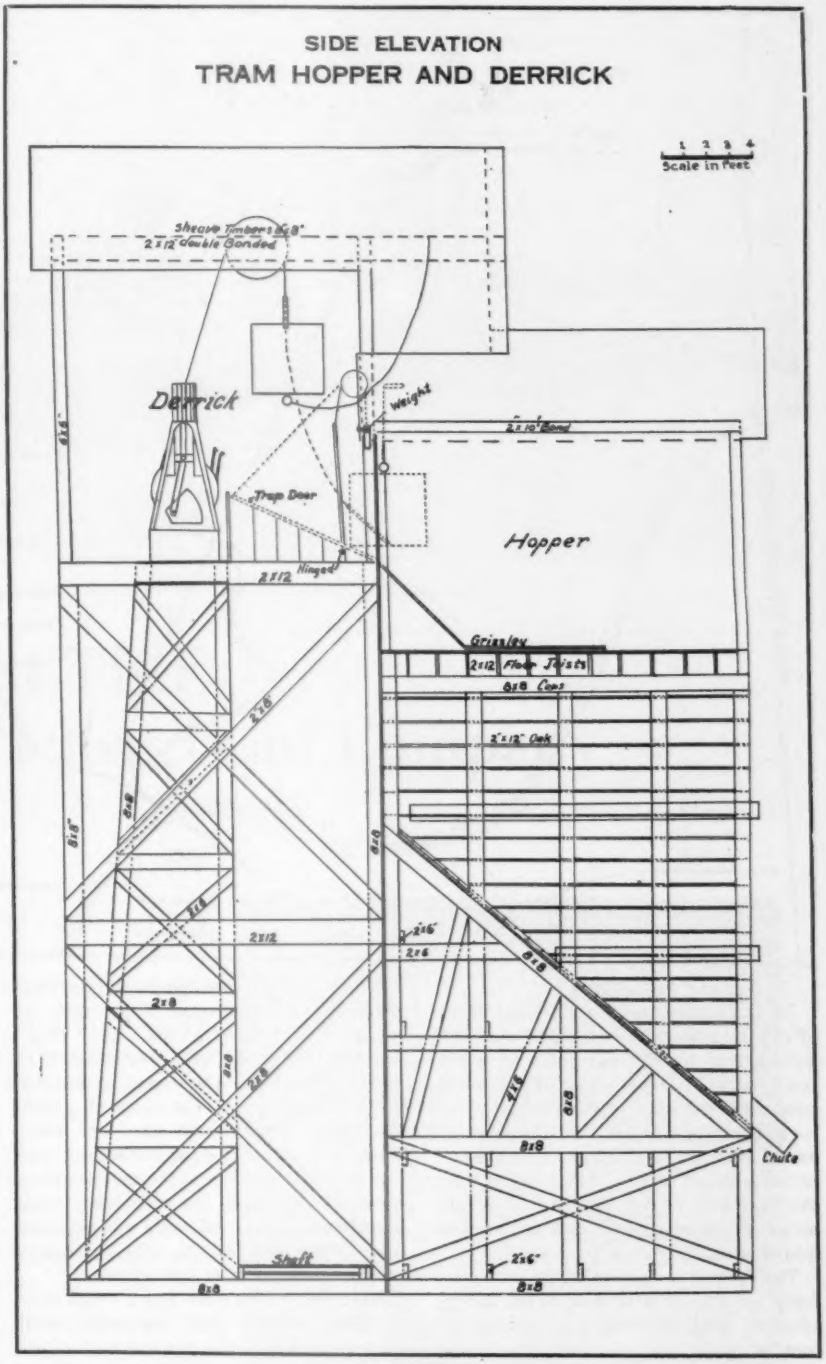


FIGURE 4

The mine dirt, as it is dumped from the can, passes over a grizzley, set at a 45-degree angle and is made of 60-lb. rail. The rails are 5 ft. long and 6 bars wide, spaced 8 in. apart and are held in place with tie rods and cast-iron spacer blocks. The over-size boulders roll down on a flat screen, or grizzley, resting on top mill bin timbers. This screen is constructed similar to the grizzley, except the rails are 7 ft. long and 8 bars wide. One or two men (screen apes) break the large boulders with sledges until they will pass through the opening.

Of the companies using electric power here, only one company generates its own power. The rest of the companies purchase their power from The Empire District Electric Company, who operate a 125,000-hp. steam plant on Spring River, some 15 miles from Picher.

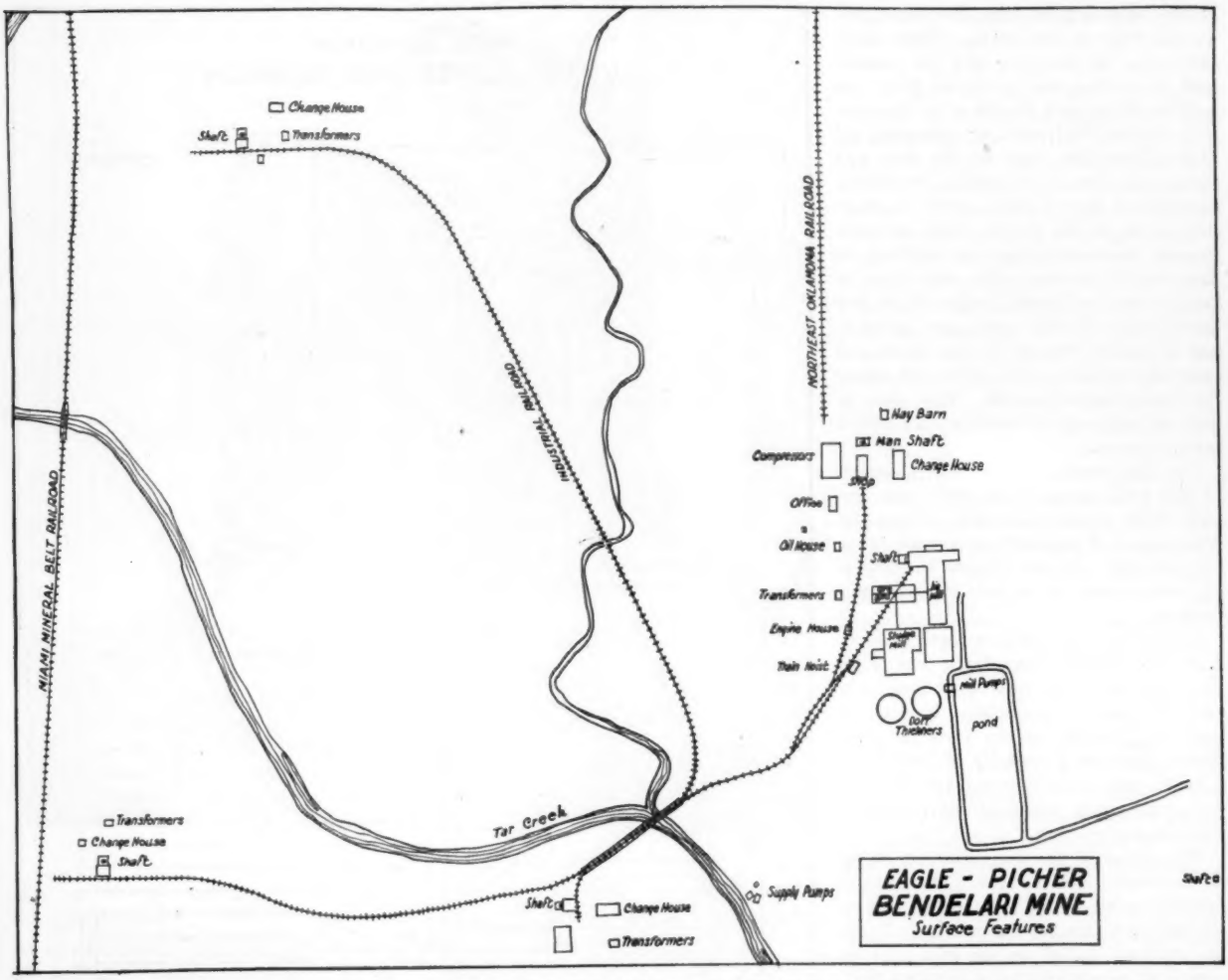


FIGURE 5

In the maintenance and replacements of electric motors, it has been found very satisfactory to let their work on a contract basis, at a certain price per horsepower per month. It is to the contractor's advantage to see that the bearings are in good shape, oiled properly, motors not overloaded and to change them when the load gets heavy. In fact, it is just motor insurance, and motors running means plant operation.

The contractor maintains an inspection force as well as a trouble crew, the inspectors keep checking and testing motors in order to anticipate trouble as much as possible and change motors before one is burned up. This service covers motors, oil switches, controllers and grids. The rate appears to be high, but the company does not have a large sum of money tied up in duplicate motors, bearings, coils, etc., and expensive coil-making equipment, nor does it have to carry a crew of electricians large enough to handle several sources of trouble at once. When all is considered, the motor insurance system is a saving over the company way of doing their own motor work.

This company maintains a complete machine and carpenter shop near its main office in Picher, Okla. Both shops are fully equipped with shop machinery to handle all repairs to operating machinery and equipment. The shops also build the tram cars, ground cars and cans. These are all of company standard and are interchangeable with any company mine. In addition, the machinery from abandoned mines and mills are repaired and either reissued to other company mines or sold to other operators.

Each individual mine has a small shop equipped with a drill sharpener, drill press, power saw and air hammer. This is sufficient to take care of small jobs and relieves the main shops of such minor work.

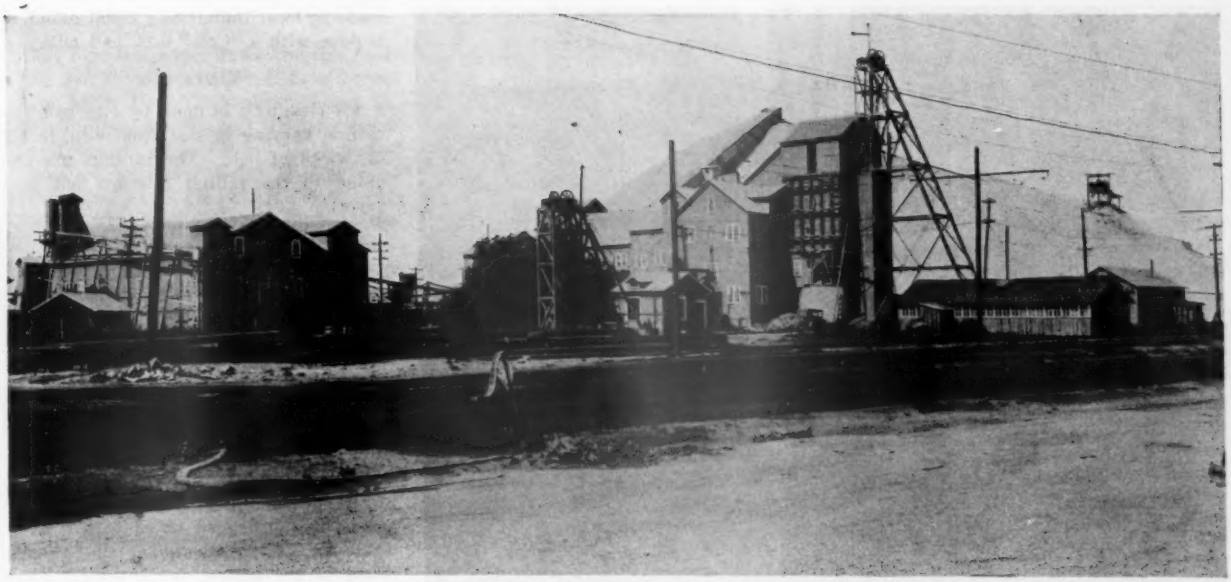
The mine shop crew consists of two men on top, one blacksmith and one compressor man, who assists the blacksmith in sharpening steel. They also handle the hoist at the man and material shaft. One repair man is carried in the mine; he repairs the rock drills, tuggers and maintains the air and water lines.

Dull drill steel is hoisted to the surface in a special can, made of 12-in. pipe and 8 ft. long, with a bail of 1¼-in. round iron extending 24 in. above the top of the can; the bottom is 2-in. oak held in with two cross-bolts. These cans will hold about 60 pieces of drill steel. The can is landed on a long car at the top of the shaft and run directly into the shop.

One company operates a central compressor plant with several miles of air lines leading to their various mines. All the other companies have compressor installation at each mining lease. In some instances where a company has adjoining leases, one compressor installation will serve both properties. At this mine, the compressor building is placed close to the blacksmith shop to economize on labor. The equipment consists of two 1,250-cu. ft. belt-driven compressors driven by 150-hp. motors.

In marketing ores (concentrates) the ore buyer purchases "in the bin." The ore is loaded by hand into either wagons or trucks and pass over the scale at the mine offices where it is weighed by a representative of the seller. The ore haulers are gradually replacing their teams with trucks, as the trucks are proving very satisfactory and economical, especially on long hauls.

Two men and a (*Cont'd. on page* 875)



The Netta Mill of the Eagle-Picher Lead Company, at Picher, Okla.

MILLING PRACTICE at The Eagle-Picher Lead Company

By F. W. SANSOM *

Complete description of flow sheet equipment of the Netta Mill, which has a maximum capacity of 1,000 tons of rock per 10-hour shift—Lead and zinc ores closely associated and mined and milled together—Zinc recovery varies from 60 to 87 percent, and lead from 80 to 90 percent

THE ORES

THE lead ore is in the form of lead sulphides or galena. The zinc ore is in the form of spalerite, or zinc sulphides, also known as zinc blende or blende.

Both ores are usually closely associated, and are mined and milled together. Marcasite, or iron pyrites, is usually present and occasionally chalcopyrite, or copper pyrites, either of which are a source of trouble in concentration, especially the zinc ore as the gravities are so nearly the same.

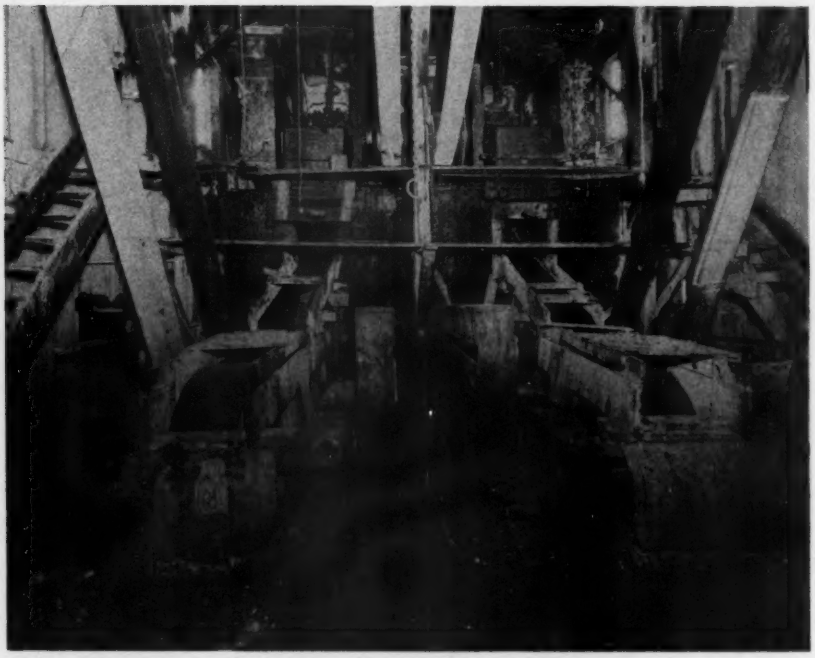
GANGUE

The principal gangue is blue and white chert, and limestone. In some deposits jasperoid or black rock, is the principal gangue, and in this, the blende is highly disseminated, making a very difficult middling product. A varying amount of calcite is always present with both ores.

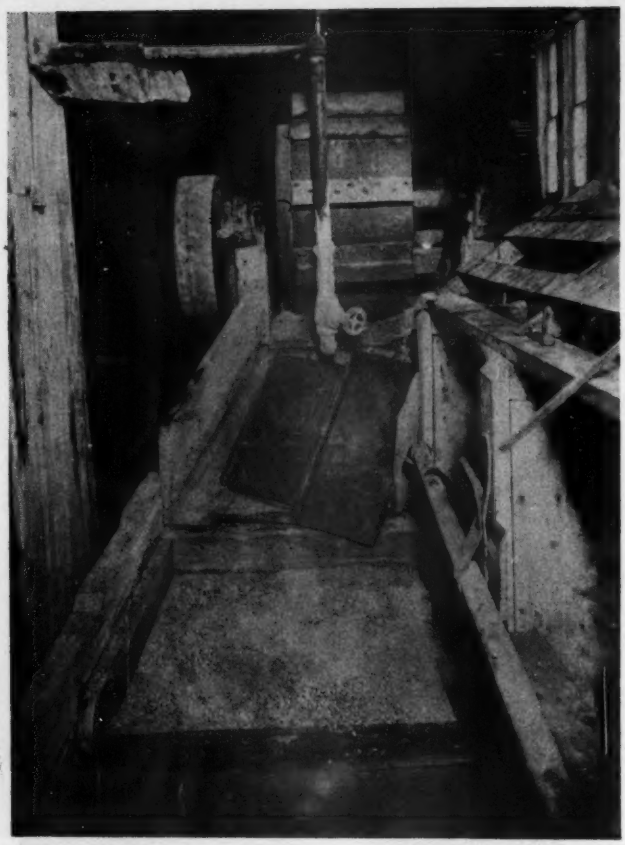
STORAGE

Each mine is equipped with a mill hopper of 200 to 500 tons capacity, and one or more field hoppers of 150 to 300 tons capacity. The dirt is gathered in end-dump tram cars, hauled by gasoline motors. The cars are then each drawn up on an incline tramway to the mill hopper.

* Mill Engineer, The Eagle-Picher Lead Company, Joplin, Mo.



24-in. Webb City boulder crusher and 42-in. Cornish rolls



Dewatering drag feed to rougher jig

Primary Grinding

First crushing is done by 24-in. Webb City Blake type crusher, then direct to 42-in. Webb City Cornish rolls. The regrinding is done by the same kind of rolls grinding to ½-in. Coarse middlings are ground on the same type and size rolls to ¼-in. Finer sized chats are ground by belt-driven high-speed rolls, to 2 mm., using manganese steel shells; all other rolls using white, hard iron made in local foundries. Final grinding is done with a "Cole" 6-ft. ball mill.

Elevating

All elevating is done by cup belt elevators, varying in size from 6-in. to 32-in. width of belt. The tailings are elevated to the tailing pile by belt conveyor.

Desliming

Dewatering and desliming is done with belt drags, and balanced cones. The drags are a local development, similar to the Dorr drag. The belt is inclined at about 20 degrees with ell-shaped steel plates on the belt at 18-in. intervals. The lower end of the belt is submerged, the drag plates scraping the sand up an incline out of the water. They have proved very efficient. The overflow water going to Dorr thickeners. The dewatering cones are suspended on springs. By a system of levers, a rubber cone-shaped valve in the bottom is operated. They are so adjusted, that when the cones are about half full of sand, or other sized material, the weight operates to open the valve, slowly discharging the material until nearly empty, when the loss of weight closes the valve. They are usually used to dewater feed to jigs, or tailings from the jig and are very satisfactory.

Coarse Concentration

Coarse concentration is done by Cooley plunger jigs of a modified Hartz type. The rougher jigs handle ½-in. size material. The middling or chat jig handles ¼-in. material, and the sand jig 2-mm. size. The smittem or hutch product from the rougher jigs, and middlings jig go to a cleaner jig. The middlings from the chat jig, and tailings from the cleaner, after screening and grinding go to a sand jig at 2-mm. size. The tailings from this jig go to the sludge mill.

Fine Concentration

All overflow water from dewatering cones and drags in the jig mill, go to a dewatering drag. An emergency settling tank is provided to take care of temporary stops in either jig or sludge mill. The sludge mill feed is elevated to a DeMier level jig, which is elsewhere described and illustrated. The smittem or hutch product goes to six Shackelford concentrating tables. The middling from the jig beds go to a 6-ft. "Cole" ball mill, the tailings go to tailing pile. The tailings from the sludge mill tables return to the DeMier level jig, which discards all tailings made in the sludge mill. The zinc—sand table middlings—go to the ball mill. The lead concentrates and lead-zinc middlings go to a lead middlings table for final concentration of the lead. The zinc concentrates go to zinc ore bins. The ball mill is in closed circuit with a desliming drag.

Flotation Plant

The overflow water from the live feed drag and from the ball mill drag go to three 50-ft. Dorr thickeners; thence to the flotation machines. The flotation plant consists of one 8-cell DeMier flotation machine, one 4-cell DeMier machine and two Butchart flot machines. The lead flotation concentrates are recleaned on a Shackelford concentrating table. The zinc concentrates go to a 3-disc 6-ft. American filter.

Flow Sheet

The ore from the mine is stored in a 400-ton hopper from which it goes to two 24-in. Webb City Boulder crushers, thence to two sets of 42-in. Cornish rolls, then to two 24-in. dirt elevators. Then it is sized to ½-in. by one 4-ft. x 5-ft. x ½-in. Hummer screen and one 4-ft. x 5-ft. x ½-in. Leahy vibrating screen. The over-size is in closed circuit with two sets of 36-in. Cornish rolls. The under-size from the screens, goes to two 22-in. dewatering belt drags. These drags provide a uniform dry, deslimed feed to the rougher jigs.

Rougher Jigs

The two rougher jigs are 6-cell 42-in. x 48-in. The coarse middlings are drawn from the jig beds, by a special type device and go to the 22-in. chat elevator, thence to a 4-ft. x 5-ft. x ¼-in. Leahy screen. The oversize in closed circuit with a set of 42-in. Cornish roll, the undersize to the middlings jig. The hutch products or smittem from the first four cells of the rougher jigs, go to an 18-in. smittem elevator thence to the cleaner jig; the hutch product from the last two cells goes, with the coarse middlings, to the middlings jig. The jig tailings are deslimed, and go to the tailing elevator, the cone overflow going to the sludge mill.

Middlings Jig

The middlings jig, 6-cell 42-in. x 48-in., takes the middlings products from the rougher jigs, together with the product from a dewatering tank, which takes care of a certain amount of coarse material in the overflow from the belt drags, which feed the two rougher jigs. The middlings are drawn from the jig beds with the same device as used on the rougher jigs, and these together with the hutch product from the last two cells, go to the 20-in. sand elevator. The tailings are deslimed by a 4-ft. x 5-ft. DeMier cone, and go to the tailing elevator.

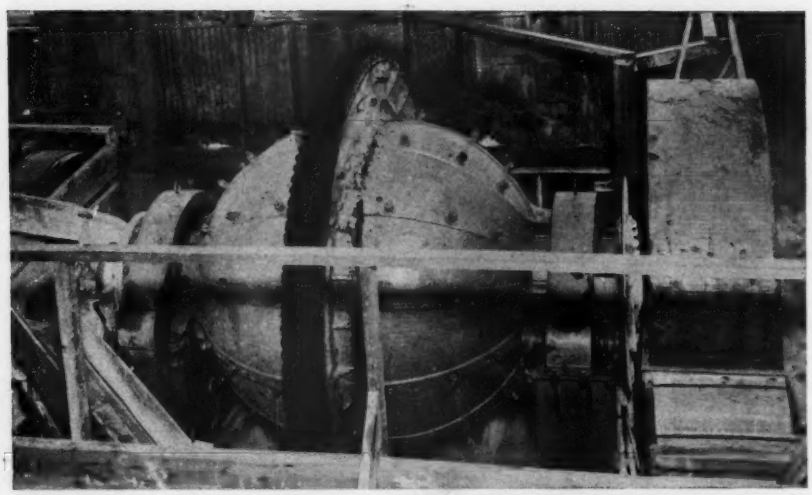
The Cleaner Jig

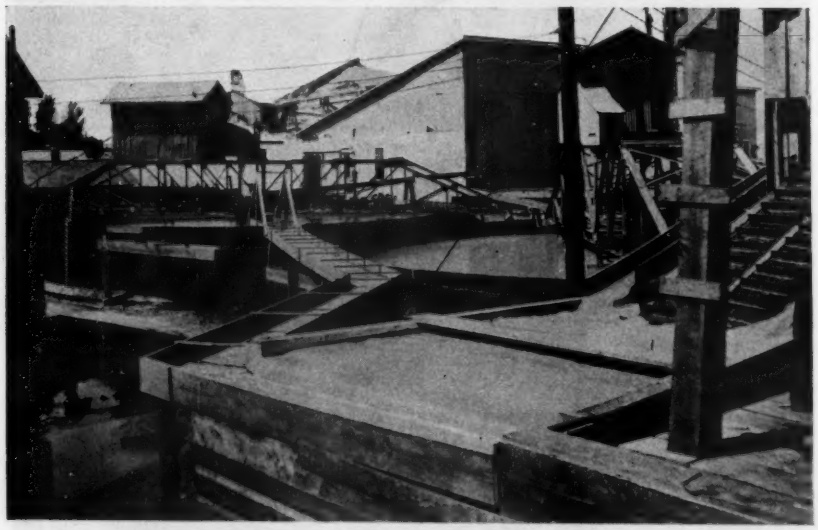
The cleaner jig is 7-cell 36-in. x 42-in. The hutch product from the first two

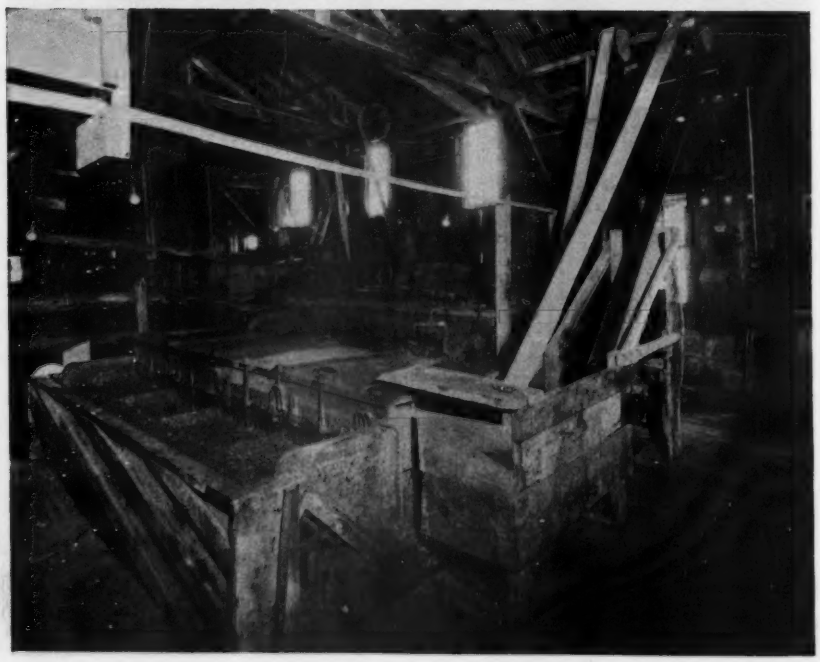
Upper—Jig mill showing rougher and cleaner jigs

Center—DeMier level jig showing raking device

Lower—Concentrating tables







cells is a lead concentrate. The coarse lead is removed by shovel from these first two cells, as it accumulates. The hutch product from the third cell is a lead zinc middling and returns to the smittem elevator. The hutch product from the last four cells is a zinc concentrate. Coarse zinc is removed by shovel from these beds as it accumulates. The tailings are dewatered in a small "catch box," and go to the sand jig.

The Sand Jig

The sand jig is 7-cell 32-in. x 36-in. The function of this jig is to treat the reground middling from the middlings jig, and the cleaner jig tailings, all of which are reground to 2 mm. by a set of 36-in. high-speed belted rolls, in closed circuit with a 4-ft. x 6-ft. x 2-mm. Leahy screen. The hutch product from the first cell is returned to the 20-in. sand elevator, and jig circuit. The hutch product from the balance of cells is a zinc concentrate. The tailings from this jig go to the sludge mill.

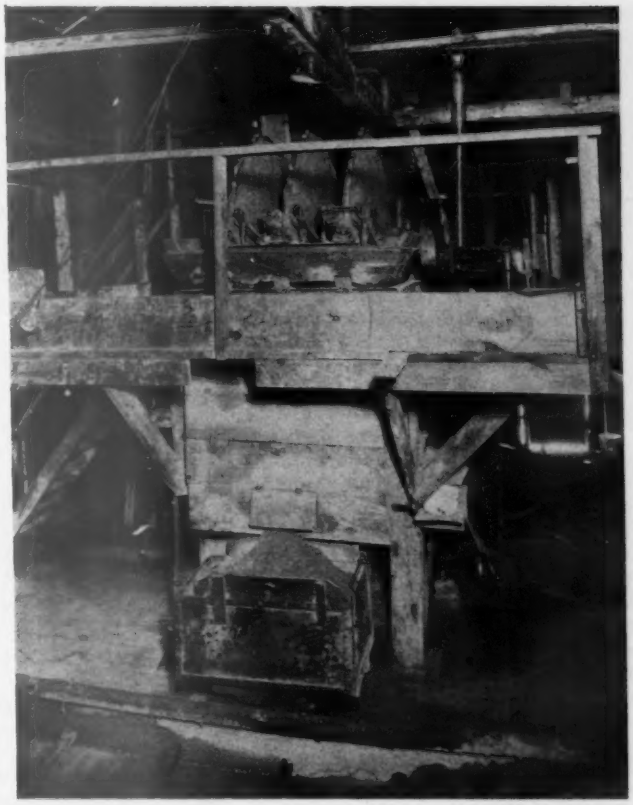
The Sludge Mill

The sludge mill treats the sands and slimes, from the dewatering and desliming drags, and cones, etc., in the jig mill. They come from the jig mill with a large amount of water, and must therefore be first dewatered. This is done by a 20-in. belt drag, which discharges the sand into an 18-in. feed elevator. This sand is again dewatered, and fed to a 6-cell DeMier level jig. This jig is a slight departure from the standard jig, in that all cells are level, whereas in the standard jig, there is a drop of 2 in., on each successive cell, to facilitate the travel of jigged material to the discharge end, requiring considerable current of water, both in speed and volume. The forward or discharging movement of the jigged material, on the DeMier jig bed, is accomplished by a series of suspended rakes, operated by suitable cam and lever device. These rakes operate much like the Dorr drag classifier, and are elsewhere illustrated in this article by photograph. The intent of this apparatus is to create a fairly quiet condition of water movement on the jig beds, thereby permitting a more effective settling of the fine mineral values, and a consequently smaller loss of these values, in being carried over the end of the jig with the top water, into the jig tailings. It has proved very satisfactory and efficient. The middlings products, are very heavily drawn from the bed of each cell, and sent to the ball mill for fine grinding, and flotation treatment. No concentrates are made on this jig. The hutch

Upper—8-ft. Cole ball mill
Center—Dorr thickeners
Lower—Flotation plant

product is recleaned on concentrating tables. All table tailings are returned to the DeMier tables. All table sand middlings go the ball mill circuit. The lead concentrates, including the lead-zinc middlings, are sent to one lead table, where the lead concentrate is finally recovered, the zinc and zinc-lead middlings being returned to the lead table circuit; the tailings water returning to the main table circuit. The purpose of this lead table is to make a higher percentage recovery of the lead concentrate, and make a better grade of lead than can be done on each table in the main table circuit.

The zinc concentrate is made on each table in the main table circuit. In the sludge mill, then, all tailings are discarded from the DeMier jig, and all concentrates are made on the tables. The use of the DeMier level jig in the sludge mill has accomplished several things, as follows: Displaced 10 concentrating tables, increased the capacity of the sludge mill, decreased the tailing losses, and provided a richer feed to the ball mill.



American continuous filter

Ball Mill

The ball mill is a 6-ft. "Cole" mill. The feed consists of the middlings from the jig bed of the DeMier jig, and the zinc sand middlings from the tables. It is found advisable occasionally, when the table feed is unusually rich, to divert the tailings from the first two tables to the ball mill, and the flumes are arranged to provide for this emergency. The feed is elevated by an 18-in. elevator into an 18-in. belt dewatering drag, the overflow returning to the 20-in. belt drag, the sand to a 20-ton storage hopper for ball mill feed, from which it goes to the ball mill, with the required amount of water added.

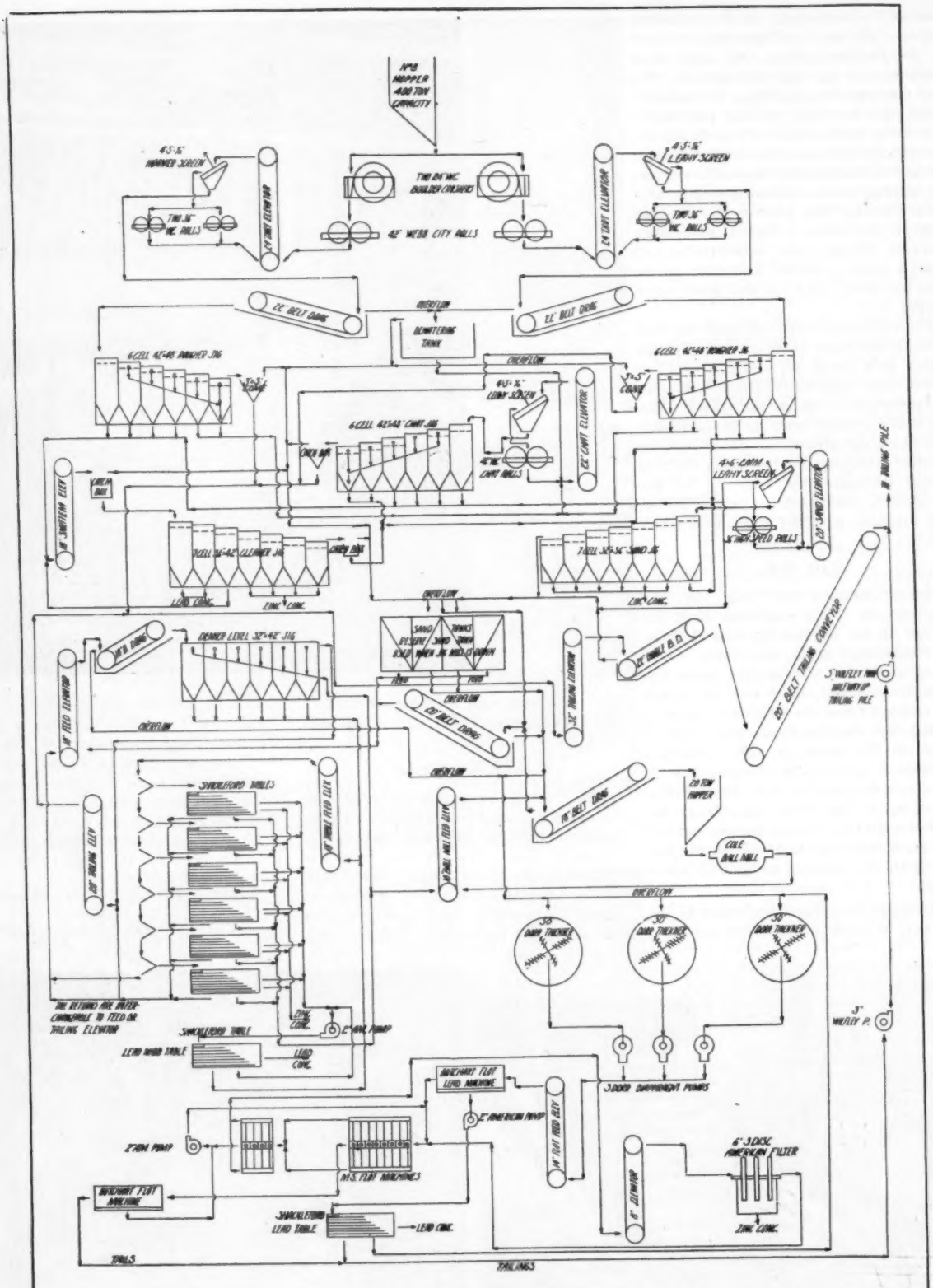
The pulp discharge is returned to the ball mill in closed circuit with the drag. This discharge can be diverted back to the DeMier jig circuit, if the ball mill becomes overloaded.

Flotation Plant

The flotation plant consists of two Butchart flot machines, and two DeMier machines of the Minerals Separation Company type. The overflow from the 18-in. and 20-in. belt drags in the sludge mill is divided to three 50-ft. Dorr thickeners, the overflow from these going to the mill pond storage system. The thickened pulp is drawn by three Dorr diaphragm pumps, elevated by a 14-in. flot feed elevator into the first Butchart flot machine. This is a lead machine, the lead froth going to a 2-in. American centrifugal pump, and then to a Shackelford concentrating table, where a high grade lead concentrate is made, all other products from the table returning to the

Below, left—Double belt dewatering drag

Right—Tailing dewatering drag and feed to tailing conveyor



FLOW SHEET—NETTA MILL

thickeners. The tails from the lead machine go to the first zinc roughing machine. The froth goes to a zinc cleaner machine, and the tails to a Butchart recleaner. The tails from the zinc cleaner return to the zinc rougher, and the froth goes direct to a 6-ft. 3-disc American continuous filter. The froth from the recleaning machine returns to the zinc rougher, and the tails, which are the final flotation tails, are elevated by two Wilfley sand pumps, to top of the tailing pile.

The overflow from the filter returns to the first zinc machine, the dried zinc pulp goes to the concentrates bin.

Flotation Reagents and Costs

Lead treatment:

Frothing agent—Cresylic acid.
Reagent for lead—Sodium silicate.
Reagent for lead—Sodium xanthate.

Zinc treatment:

Frothing agent—Cresylic acid.
Reagent for zinc—Copper sulphate.
Reagent for zinc—Barrett No. 634.
Reagent for zinc—Sodium xanthate.
Reagent for zinc—Sodium Silicate.

Cost of reagents per ton of lead and zinc ore:

Copper sulphate.....37 cents per ton
Sodium xanthate....15 cents per ton
Barrett No. 634..... 5 cents per ton
Cresylic acid.....17 cents per ton
Sodium silicate.....05 cents per ton

Total cost.....74.5 cents per ton

Milling Results

The mineral values in the ores mined at our various mines, vary from 3½ blende to 11 percent blende and from 0.5 percent galena to 3 percent galena. The combined lead and zinc values vary from 4 to 11.5 percent.

The tailing losses vary from 0.7 to 1.25 percent metallic zinc.

The percentage of zinc recovery varies from 60 to 87 percent. The lead recovery is much higher running 80 to 90 percent. The production of zinc from the three departments is divided roughly as follows:

From the jig mill.....55% to 65%
From the sludge mill.....12% to 22%
From the flotation mill.....21% to 27%

The tailing losses from the three departments is as follows:

Jig mill 70%
Sludge mill 20%
Flot mill 10%

The capacities of the different mills vary from 30 to 60 tons of rock per hour. The mine is usually operated on an eight-hour shift, and the mill a 10-hour shift.

Tailing Disposal

Tailings from the rougher jig, chat jig, and the sludge mill are elevated by a 32-in. elevator to a double 22-in. belt drag, the overflow water returning to the sludge mill. The dewatered tails are conveyed to the tailing pile by a 20-in. belt conveyor. The flotation tailings are pumped to the head of the conveyor and used to wash the tailing down the tailing flumes.

Power

All power is furnished by electric motors as follows:

Two 100-hp. motors in the grinding room; one 150-hp. motor drives the jigs; one 25-hp. motor drives tailing elevator; one 15-hp. motor drives tailing drag; one 20-hp. motor drives tailing conveyor; one 100-hp. motor drives sludge mill; one 50-hp. motor drives flotation machines; one 25-hp. motor drives filter and elevators; one 50-hp. motor drives ball mill; one 25-hp. motor drives Gould triplex mill pump; one 15-hp. motor drives Gould centrifugal mill pump; one 20-hp. motor drives Wilfley slime pump; one 112-hp. motor drives dirt skip hoist; one 75-hp. motor drives man shaft hoist.

The flow sheet described is that of the Netta mill, which has a maximum capacity of 1,000 tons of rock per 10-hour shift.

The other mills of the company vary in capacity, from 400 to 750 tons per 10-hour shift.

The flow sheets of these vary slightly from the one described, and some of the machinery is different but the milling practice is substantially the same.

SURFACE PLANT at TYPICAL OPERATION
(from page 868)

boy usually constitute a loading crew, the two men loading at the bin and unloading in the door of the box car, and the boy, or "backer," shoveling the ore back into the car. Loading prices range from 50 cents to $1 per ton, depending on the distance hauled. The horse-drawn wagons will haul from 6,700 to 7,500 lbs. of ore per load. However, some ore haulers will not permit their teams to pull over 6,200 lbs., while others will load to the pulling capacity of the team. With truck loading the load limit is governed by the capacity of the scale, 12-ton scales being the maximum size now in use.

ACCIDENT PREVENTION in the TRI-STATE DISTRICT
(from page 856)

to mines making records of no lost time accidents. (A lost time accident is one on account of which a man loses time other than on the day of injury, or is paid compensation for partial permanent disability, even though there is no loss of time.) The "Pete" flag is awarded for three months, or 3,500 continuous man-shifts without a lost time accident. The "New Broom" flag is awarded for six months, or 8,000 continuous man-shifts without a lost time accident. The "Combination" flag is for the operation during an entire year without a lost time accident. These flags are shown by photograph No. 11.

The *Explosive Engineer's* National Safety Trophy for 1926 was won by the New York Mine of the Cortez-King Brand Mining Company, and the 1927 trophy was awarded to the Muncie Mine of the Federal Mining and Smelting Company, both of which are in the Tri-State District. In the 1928 contest, honorable mention was awarded to three mines in this district, the Jaybird, Webber, and West Side mines, of the Commerce Mining and Royalty Company. The Jaybird and Webber had no lost time, and the West Side had only five days' lost time due to accidents.

Accident records submitted by all participating companies for 1924, prior to the campaign, showed for every 1,000 man-shifts worked in the mines, 23½ were lost on account of accidents. In 1928 the same companies reported only 10½ man-shifts lost per 1,000 shifts worked. This is a decrease of 55 percent in the lost time due to accidents, and has been accomplished in spite of the fact that the mine workings have been greatly extended and the consequent possible hazards greatly increased.

The expenditures directed toward accident prevention and general improvement of working conditions in the past five years amount to at least a half million dollars, all without any charge to the employes.

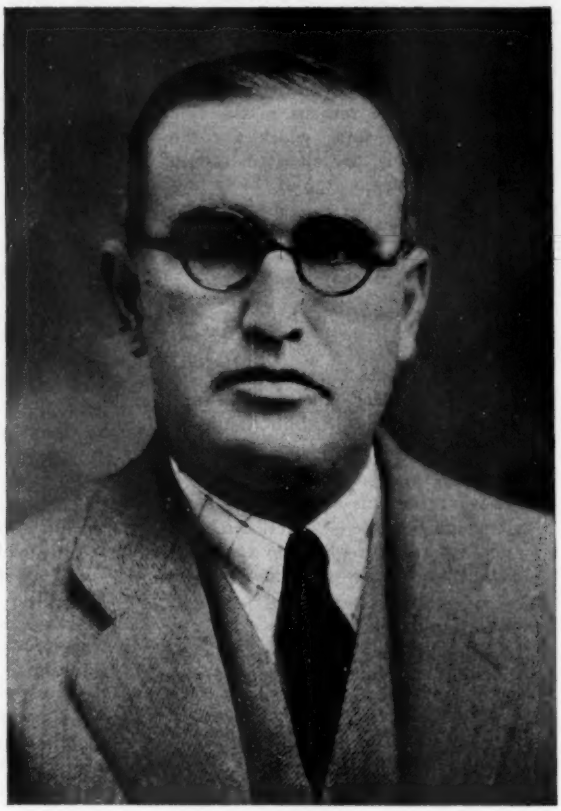
It is felt that these expenditures are paying excellent dividends, both in actual cash savings and in human welfare. This accident prevention work will continue as an indispensable part of the mining activity in the Tri-State District.

AMALGAMATION PROCESS EFFECTIVE IN TREATMENT OF LOW-GRADE GOLD ORES

With the development of cyanidation including fine grinding with ball or rod mills, there is a marked trend for the abandonment of amalgamation in the recovery of precious metals. Although in many cases this may be justified, an exception has been noted in experiments conducted at the Rare and Precious Metals Experiment Station of the Bureau of Mines, in cooperation with the University of Nevada.

A mine near Virginia City, Nev., milled a very low-grade gold ore by cyanidation, allowing 72 hours for the treatment period. Profit depended on milling increased tonnage. This was accomplished by eliminating the colloidal slime through a centrifugal classifier. Late experiments show that after the coarse gold is removed by amalgamation, 24 hours is a sufficient period for cyanidation. This allows for handling all of the increased tonnage.

SAFETY and INDUSTRIAL RELATIONS at Eagle-Picher



By O. N. WAMPLER *

A Safety Department with a director who devotes whole time to work part of Safety program of this company which is steadily decreasing its accident record—Causes of accidents and methods adopted to prevent them outlined

THE Eagle-Picher Lead Company is steadily reducing its accidents, as increased efficiency is gradually reducing its other mining costs. The safety department is composed of a safety director and two assistants, who spend their entire time in and about the mines. For a number of years the safety engineer's attention was devoted entirely to the physical hazards. The greater part of his time was spent in examining the roof, as an injury caused by a fall of rock from the roof is usually very serious and often fatal. Very little attention was given to other underground conditions or to the guarding of equipment.

Later, mill machinery was protected with practical guards. Convenient runways and stairways with protecting hand rails were installed throughout these mills. These precautions were necessary, but did not seem to produce any marked effect in reducing accidents. Up to that time the company recorded the individual accidents for reference purposes only. Since the accidents were not being reduced, it was decided to keep accurate statistical records, listing: *First*, all accidents as to occupation; *second*, all accidents as to cause; *third*, parts of body injured; *fourth*, all lost-time accidents as to occupation, days lost, and compensation paid; *fifth*, total mine expenses as to compensation, medical, hospital, adjusting, accident prevention, legal expenses, etc.

The above records are kept on each mine and a comparison can then be made between each mine and the company as a whole. From these statistics it was shown that the greatest aggregate loss was not from falling roof. The district records show that about half the mine fatalities are from fall of rock. However, only about one-seventh of the fatalities which have occurred in the Eagle-Picher mines were caused by falls of roof. Therefore, while the roofs are inspected regularly by the safety engineers, much more time is devoted to the other causes of accidents.

The company has had at least its share of fatalities and serious accidents, caused by premature explosions when loading holes. The writer has acted as a mine safety engineer during the past 18 years, and the greater part of his work has been in the local Tri-State zinc and lead mines. He has made either a personal investigation or has had a report of practically all of the premature explosions which have occurred when holes were being loaded during this 18-year period. From these reports and personal investigations, there was not an accident where it was shown that the detonating cap was not in the hole at the time of the premature explosion. Therefore, it is the writer's opinion that the explosion of the detonator is the primary cause of practically all premature explosions which have occurred in the Tri-State district. In making up the shot, the sensitive end of the detonator may extend to the outside edge of the dynamite stick. When the shot is pushed back in the hole, the paper covering may be scored so that the detonator may strike the side of the hole with such force that a premature explosion will occur. Or the shot may be rammed back in the hole with such force that the tamping bar copper spike may hit the detonator. Again, the force may be such that the stick of dynamite is collapsed, and the detonator strikes the rock. In the last two and one-half years the company has used a heavy cardboard cylindrical cover, which is slipped over the made-up shot. This cover is the same length as the stick of dynamite, and is just large enough to slip tightly over the shot, so that the fuse is held rigid between the shot and the protecting cover. This cover protection is firm enough so

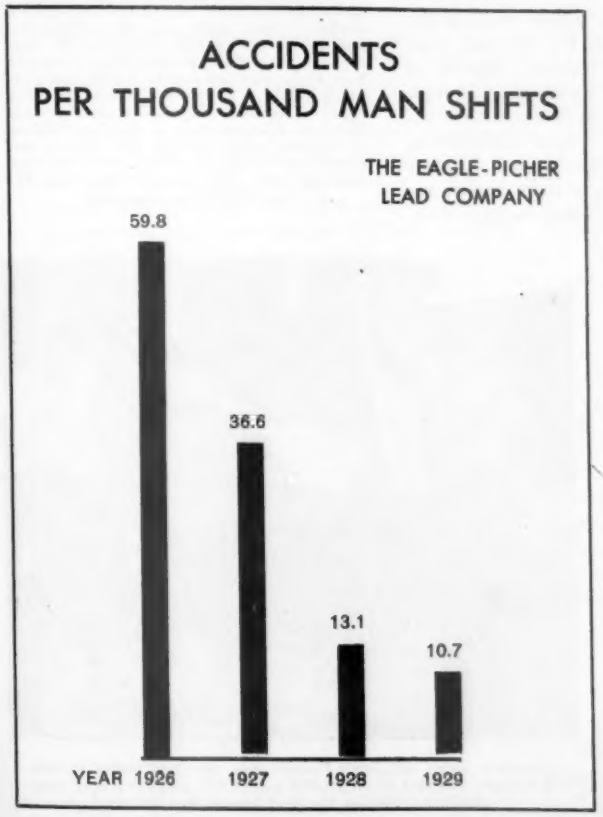
* Safety director, The Eagle-Picher Lead Co.

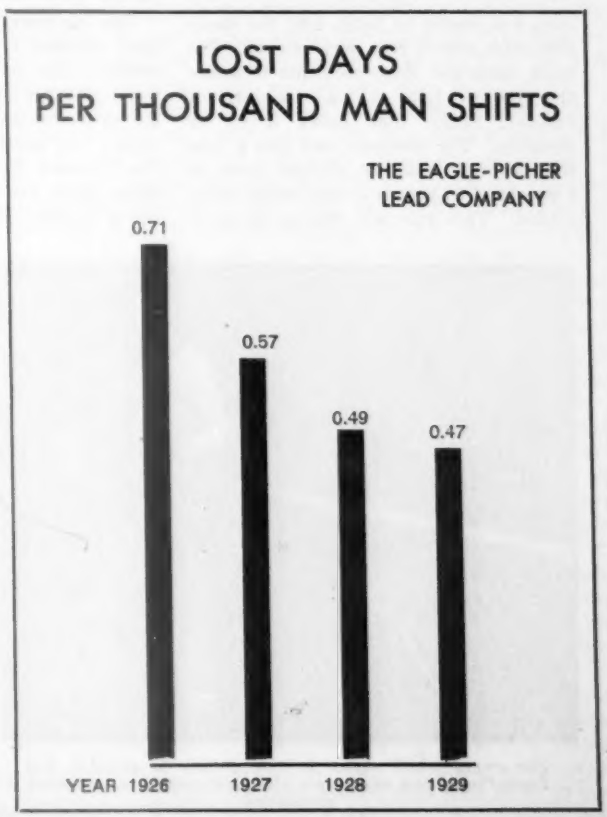
Earl Eastwood, veteran shoveler for Eagle-Picher, believes cleanliness promotes safety. Tracks and floor of Eastwood's drift are always clean

that there is no danger whatever of the shot collapsing. This completely protects the detonator from any danger of being prematurely exploded by an outside blow. This covering will also, no doubt, tend to protect the shot from a hot hole. The company feels that this is one of its outstanding improvements in the protection of its men. Before the use of this protector periodic explosions occurred when men were loading holes. With its use there has not been a premature explosion. The writer firmly believes that there would be many deceased powder men still living if this protector had been used in previous years.

All the men are required to wear wire screen goggles when sledging boulders and when collaring or blowing holes. The more serious eye injuries have occurred in sledging. The prevailing flint rock is very hard and the flying particles cause more serious injuries than the lime or granite formations of other districts. The wearing of goggles is rigidly enforced, and when the safety engineer does occasionally find a shoveler sledging and not wearing goggles he immediately gets in touch with the foreman, and a real live (conference) is held right on the job between the offending shoveler, his foreman, and the safety engineer. Information is immediately sought as to why the shoveler did not wear his goggles, how long he has been with the company, etc. Often the new man may claim he was not instructed to wear goggles; if this is true, the foreman is at fault. But the shoveler is often inclined to give such an excuse. However, the main result of this immediate so-called conference is that this shoveler is not likely to violate this rule in the future. The goggles are furnished gratis by the company, and on each inspection trip the safety engineer makes it a special point to see that the foreman has each man supplied. Formerly there were several losses of eyes, but since the enforced use of goggles the case is very rare where a serious eye injury results from sledging.

Another cause of accidents is when the men are loading cans with ore. These





Eagle-Picher's Crutchfield mine placed their Safety Record Flag on the highest point. This mine was runner-up in the first Explosives Engineer Tropky Contest. They failed by only a slight margin in winning the national safety trophy

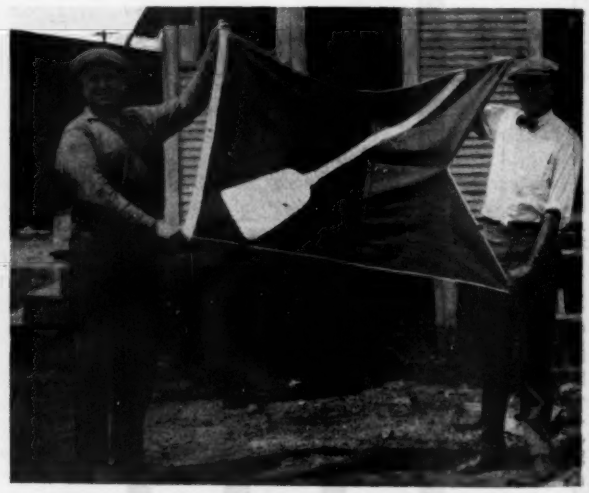
cans are loaded by hand, and the sharp flint rock causes very serious cuts. The main cause for these accidents is where the shoveler tries to load too large a boulder, rather than break it up by sledging. The company now has a rule that all rock shall be sledged down to a weight of 50 pounds or less before being loaded. This rule will reduce the accidents from cuts and bruised fingers, rocks falling on feet, and strained backs. This is one rule, however, which seems very hard to enforce. A big husky shoveler will often load a 75 to 100 pound boulder rather than take the time to break it up. He can easily be educated to protect his eyes, but it is hard to convince him that he is not a second Samson.

Buckets are used for hoisting both ore and men in most of the mines of the district. The tub hooker, whose work is at the bottom of the shaft, is required to remove any boulder which might fall from the bucket when it is being hoisted. These boulders are thrown into an extra can, kept at the bottom of the shaft for this purpose. All tub hookers and tub runners who work in or near the bottom of the shaft are required to wear the Army type steel helmet. These helmets save many lives, as a possible fatality is often turned into a slight head injury. Four men ride these buckets when being hoisted or lowered in the shaft. The hoistermen are required to hoist or lower the men at a speed of not over 500 ft. per minute. This low speed reduces the danger in handling men in the shaft. Also the hoisterman is not allowed to hoist the men above the surface. Many accidents have occurred when men were hoisted into the head frame. By stopping the men at the surface the above danger is avoided.

The company has given bonuses for good accident records for the past four years. The mine foreman receives a bonus of $20 when his mine goes through the entire month without a lost-time accident. In order to create competition, the foreman with the largest crew of those mines showing a clear record receives an addi- (*Continued on page* 894)

Carbide dispenser at the Netta Mine of the Eagle-Picher Lead Company. The frame is made out of ¾-in. rods welded together. There is a cone with a slot in it about 2 in. from the lower end with a blade and handle to regulate the flow of carbide. The cone is welded onto the screw top of the carbide can from which has been cut out a 6-in. opening to allow the carbide to come down into the cone. This top can be taken off and put on the next can when the present can is empty. The box below the cone rests on a plate welded onto the legs; it has a slotted screen cover onto which the spilled carbide drops and can be picked up and put in the carbide container the men carry. The dust drops down into the box, to be emptied in the waste can provided for it. There are many different types of carbide dispensers used in this district. The designer of this one claims it not only saves carbide but reduces the hazard of cutting the hand when reaching into the can; also protects men from being injured by explosions

The emery wheel shown in this picture is guarded, but Eagle-Picher tool sharpeners also wear goggles as an extra precaution



Goodwin mine of Eagle-Picher was the first mine in the Tri-State District to go 10,000 manshifts without a lost time accident. This is the first broom flag awarded.

Tri-State District MINING METHODS

By R. E. ILLIDGE *

An outline of the methods of mining in Tri-State District including data on Method of Mining, Drilling and Blasting, Shovelling, Haulage, Hoisting and Distribution of Supplies

A FEW remarks relative to the occurrence of ore are helpful in understanding the mining problems in this field. The ore minerals are sphalerite and galena. Production figures show that approximately six times as much "jack" is produced as "lead" and that the average value of the mine run for the camp is between 6 and 7 percent, meaning that from 100 tons of mine run 6 or 7 tons of combined concentrates are produced. Some few mines have had very high recoveries, as high as 20 percent, while others have experienced difficulty in making a profit.

NATURE OF ORE DEPOSITS

The main ore horizon is approximately 270 ft. below the surface. Minor levels exist from 180 to 240 ft., but they are relatively of much less importance than the 270-ft. or lower level. Mineralization on the lower level is very consistent and persists over a large horizontal extent. Mineralization of the upper level is usually confined to smaller areas and in many localities it is entirely absent. The vertical height of mineralization varies considerable, from 4 or 5 ft. to as much as 125 ft., but the ore-bearing strata, which are sedimentaries of Mississippian age, regardless of their height all lie practically horizontal. In the lower level the sphalerite and galena are found disseminated throughout a jasper breccia as individual crystals, as lenses varying from knifeblade seams to patches several inches thick, and as the lining of cavities and vugs. In the upper levels the ores are found along the bedding planes and disseminated throughout a grayish and blue chert. In those localities where zones of shearing and fracturing are numerous mineralization enjoys a wide lateral extent, and where they are less prevalent or absent the ore-bearing strata are crowded into narrow channels following the very irregular water courses. Thus, it is seen that the deposition of ore follows no definite regular plan as in the case of most other mining fields, and as a result the actual locations for breaking ore is a matter of daily observation. A round of holes shot in a very rich face of ore may shoot the face blind. The resulting new face may be a solid unbroken wall of hard chert or flint. Or it may contain a few small fractures showing knifeblade seams of ore. A succeeding round might disclose further richness by virtue of the small seams of ore enlarging into lenses. This is a very common phenomenon, and the miners locally call it "coming in and going out." However, many persistent well-mineralized ore zones are easily followed with little or no variation in recovery. Such an ore body, if narrow and long, is locally termed a "run."

METHOD OF MINING

The method of mining employed is the room and pillar method, not to be confused, however, with the method as used in coal mining. Two shafts are sunk to the bottom of the ore, spaced usually from 100 to 250 ft. apart. The location of one shaft is so chosen that the mill and mill hopper may be designed together as a unit, and hence is called the mill shaft. The other shaft is then called the field shaft. When sinking is finished a drift is driven on a surveyed line connecting the two shafts underground. This usually gives good ventilation without resorting to mechanical means.

The prospecting program has outlined the profitable mineralized area, and the problem now is to mine the better grade of ore and leave, as far as possible, the leaner portions in pillars for roof support. Little or no timbering is necessary, as the roof can be adequately supported by pillars alone. In opening up the shafts, stopes are driven radially in all directions for the full height of the ore body, leaving pillars from 20 to 50 ft. in diameter and spaced from 20 to 100 ft. apart, depending on roof conditions. They are terminated only when reaching a property line or when encountering ore too lean to be mined, or when the drift "goes blind." A minimum of 6 ft. is stoped. This procedure results in leaving from 12 to 20 percent of the mineable ore in pillars during the stoping period, but later, when the other resources of the mine are depleted from 40 to 50 percent of the tonnage in the pillars is then

* Superintendent, Netta Mine, The Eagle-Picher Lead Company.

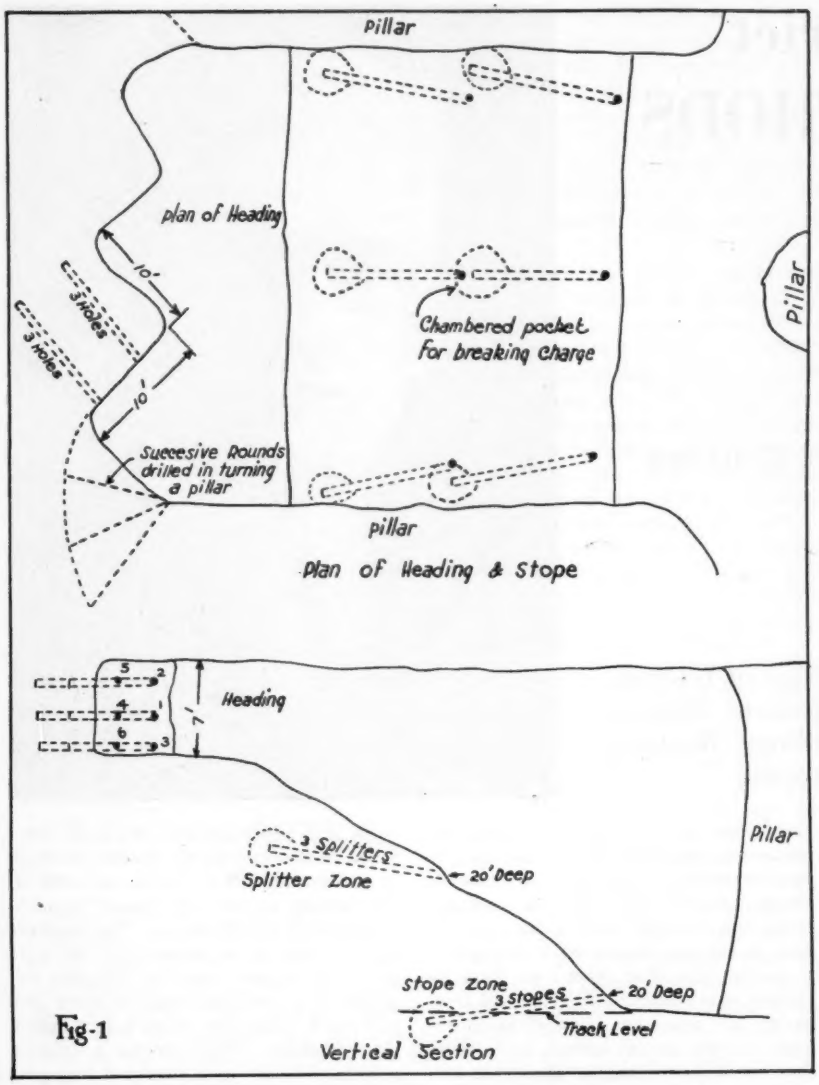


Fig-1

reclaimed. In many instances entire pillars are taken out.

Drilling and Blasting Practice

All of the popular makes of drills are represented in the field. A few one-man machines are used, but they have not met with the favor of most of the operators, and consequently the two-men machines are in the majority. They are of the water Leyner type, using 1¼-in. hollow round steel. The starter steels are 3 ft. long and the steel lengths increase 2 ft. for each succeeding change. The last change is usually as long as the original bar of steel will permit, which is about 21 ft. Up to and including the 11-ft. steels are used for heading rounds, and the longer steels are used to drill the stope holes. They are bitted with the standard 18 degrees taper cross bit. The starter gauge is 2¾ in. and the gauge on each succeeding change is dropped ¼ in. up to the 11-ft. The next changes are dropped ⅛ in., the last steel having a gauge of 1½ in.

Jackhammers use 1-in. hollow hexagon steel cut in lengths of 1, 2, 3, 4, and 5 ft. Starters have a gauge of 2 in., and each succeeding change drops ⅛ in., the last change being 1½-in. gauge. Air pressure is maintained at 110-lb. gauge.

If the height of face is not over 10 ft. the drill is mounted on a post, the height of the face and the round drilled as shown in *Figure 1*. For heights over 10 ft. the heading is carried on a 7-ft. post about 30 ft. in advance of the stope, as shown in *Figure 1*. When more than one high heading is being mined, the machine man in the heading is kept busy drilling from the 7-ft. post and never drills any other rounds. The holes in the stope zone, known as "splitters" and "stopes," are drilled by a "prodman," using his drill mounted on a tripod. The slope of the stope is kept at an angle of about 45 degrees, which allows the "dirt," the local name for broken ore, to slide to the track level. The efficient heading man places a round of holes as shown in *Figure 1*. Blasting successive rounds as shown gives the face the appearance of a flight of stairs, each "step" becoming a "break" for a following round. It is easily seen that when a heading is once in the condition illustrated it may be kept that way, providing the machine man watches the length and direction of his holes carefully. The difference between a heading with successive square breaks and one with ragged, angular, or even no breaks is the difference between an efficient heading man and an incompetent one. If the ground is hard and very tight, six holes are usually drilled as shown. If comparatively soft and fractured, No. 1 hole is omitted and Nos. 2 and 3 are drilled a little closer together, the others remaining the same. The heading man is a very important man in the mine, for it is he who, under directions from the ground foreman, locates the positions of the pillars for roof support. This is especially important when the roof is high. Obviously, when a pillar is started to be turned the prodman must drill his stope holes to conform to the location as started in the heading. Any error in judgment here may cause the loss of the drift by virtue of excessive falling of the roof. A good ground foreman prides himself on the manner in which he leaves his pillars; spaced properly and left with no rough obtrusions, and large enough to adequately support the strain on them. As a result, he sees that he has the fullest cooperation with his heading man.

There is no definite rule for placing pillars. Headings are advanced as wide as safety permits, and where the roof is inclined to be a horizontal slabby formation pillars must be spotted close, in some cases as near as 15 ft. Where the roof is more or less rugged and the bouldery appearing rocks well keyed in, the space between pillars can be then truly arched and the intervening distance can be as much as 80 or 90 ft. The average thickness of pillars is about 30 ft., and they are spaced about 50 ft. apart. The location and size of pillars is governed almost exclusively by the condition of the roof, and as a result pillars are not usually found in rows. Enough leeway is taken, however, to allow the main-line tracks to be laid without undue curvature.

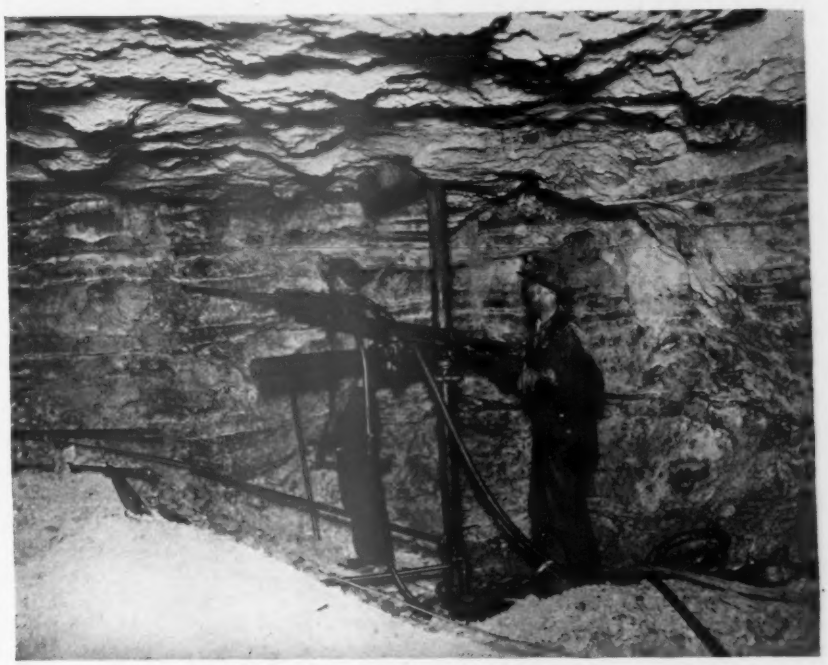
When the heading has been advanced about 30 ft. ahead of the splitter zone, as shown in *Figure 1*, the prodman sets up his drill on a tripod and drills the splitters as shown. At this stage shovelling has progressed to the point where the top of the broken ore is approximately where the splitters are to be collared. Sometimes it is necessary to shovel back

some dirt so that the splitter may be started at the proper location. This allows the prodman to set his tripod on the broken pile of dirt. Otherwise it may be difficult to set up on a rough, uneven ledge and at the same time collar the hole where it ought to be. The average drift takes three splitters, one on each side of a middle hole. They are drilled in a horizontal plane across the drift with an upward pitch of about 1 in. to the foot to a depth of from 18 to 20 ft. This allows the holes to be readily washed of their cuttings preparatory to the loading of the breaking charge. The maximum of burden on the back end of such a hole is from 16 to 18 ft. For the conditions illustrated the stope must be split then, for a 30-ft. face; but at the same time if the face were 40 ft. high it needs to be split only once. If the face is over 40 ft. and under 60 ft. high, it becomes necessary to split the stope with another row of splitters drilled precisely as the first ones, and so located vertically as to make about the same burden on each row. Only a few mines have been so fortunate as to have faces high enough to make splitting the stope three or more times necessary. The majority of the mines need to split the stope only once. When the hole is drilled to the desired depth the prodman prepares the back end of the hole for the breaking charge of powder. This performance is known locally as "squibbing." Each splitter is usually squibbed three times. The first charge is 15 sticks of powder, usually 35 percent gelatine, tamped tightly in the back end of the hole. The next day the hole is thoroughly cleaned out by a mixture of water and air fed through a length of ½-in. pipe called a "blow-gun." A second charge of about 30 sticks is then loaded into the pocket thus formed, and shot again. Twenty-four hours later the hole is shot again with a third charge of about 45 sticks, the pocket being thoroughly cleaned after each shooting. The pocket now is loaded with the breaking charge, which is from two to four boxes of 35 percent gelatin powder, after which it is double primed and detonated. No. 6 caps are used for detonators. An experienced prodman knows very closely how many times to squib any particular hole to gain the size of pocket necessary to hole the breaking charge.

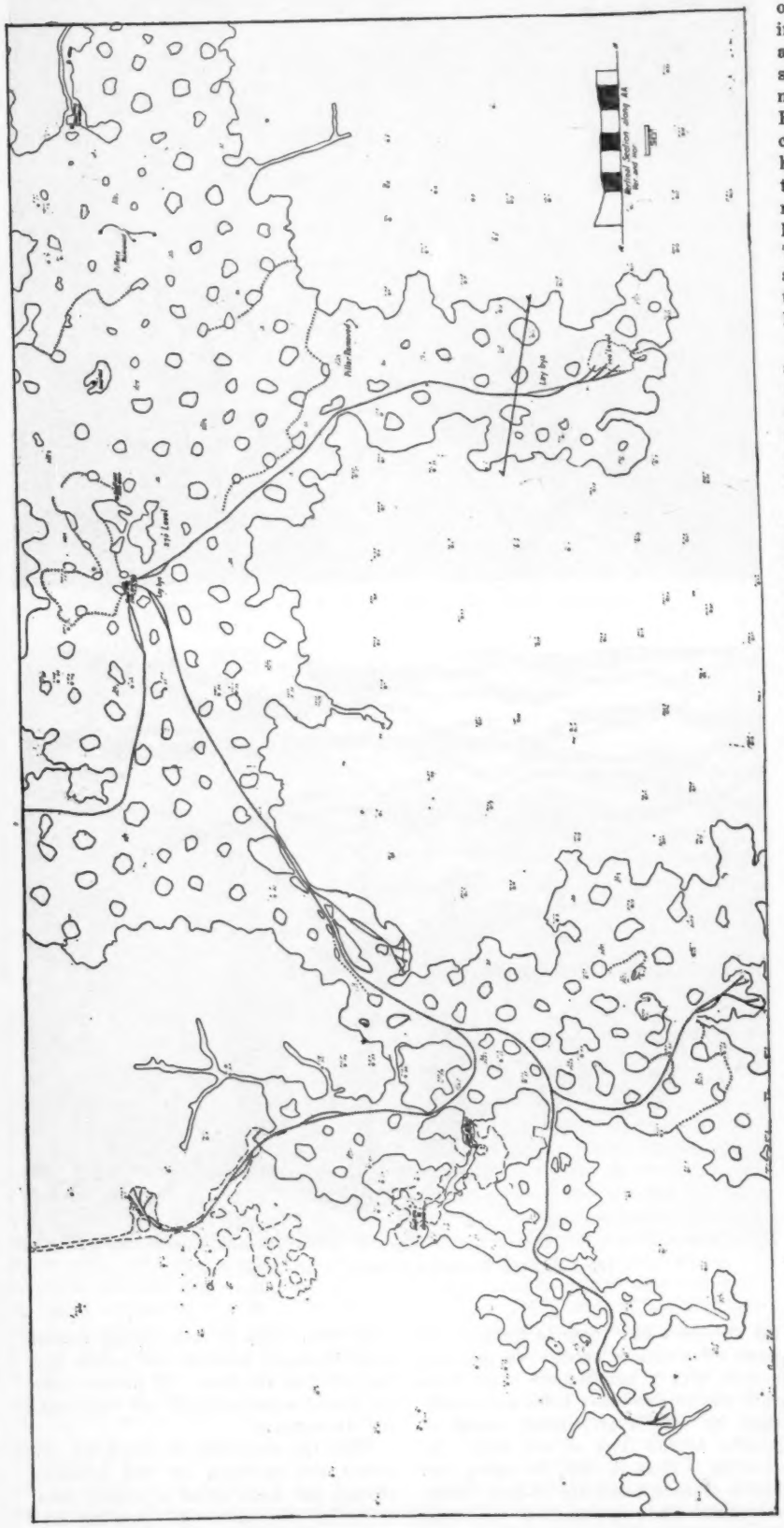
The lower row of holes, or the stopes, are drilled and treated exactly as the splitters and are placed vertically underneath the splitters, excepting, however, that they are pitched downward about 1 in. to the foot so that no high bottom will be left in the way of the tracks. In general, the prodman so places his splitters and stopes that an equal burden will be placed on the several holes shot. An average hole of this character will break from 250 to 300 tons of ore. Sometimes the resultant dirt contains boulders too large for a man to handle. In this case a man with a jackhammer drills them with one or two short holes and breaks them up with a very small charge of powder at the close of the shift. No shooting is done on shift for safety and health reasons, hence the 24-hour delays mentioned above in regard to squibbing. Stopes and splitters are collar loaded only when cavey or soft, spongy ground is encountered between the pocket and the collar of the hole. All primer shots are placed within a safety shot tube made for the purpose.

With the exception of preparing the stopes and splitters for the breaking charge, one man, called a powder man, or two if the number of operating machines demand, is in charge of all loading

Drilling a hole, and shovelers at work in a high heading



Drilling crew set-up on a round in a low heading



PLAN OF UNDERGROUND WORKING SHOWING HAULAGE SYSTEM

of holes. He looks the heading rounds over and places the amount of powder in each hole as his judgment directs. On an average, each hole is loaded with 10 sticks of powder, usually 33 percent ammonia dynamite or about its equivalent. Each hole is stemmed, after loading, with clay cartridges made for the purpose. A heading round is collar loaded only when the ground is very hard, and often it is more desirable to drill one or two extra lead holes, making a 7 or 8 hole round. This relieves the burden placed on the smaller round and materially cuts down the powder consumption. An average heading round breaks 50 tons of ore.

The powder man loads all stopes and splitters with the breaking charges. An experienced powder man possesses uncanny judgment in using the proper amount of breaking powder, and oftentimes his judgment is criticized only to prove later that his critic was in error.

A man known as "roof trimmer" inspects all parts of the mine where blasting is being done. He bars down all loose rocks and trims the roof so that it will be perfectly safe. Occasionally bad roof develops after the drift has advanced considerable distance. For such conditions in high headings, extension ladders are used. His services are always required for trimming pillars which are being formed during the stoping stage.

Shoveling

All shoveling is done with hand labor Mechanical loaders of various types have been tried out, but the good shoveler with a No. 2 scoop has given the best economical results. Cylindrical cans 30 in. in height and 32 in. in diameter, holding about 1,200 pounds of dirt, are used. They are set on four-wheel trucks called cars, equipped with rings and hooks so they can be made up into trains. In high headings when the stope is "cleaned up," that is, when all of the broken dirt is shoveled, the shovelers place 2 x 12 oak planks 12 ft. long, flooring the bottom of the drift. They cover the planks with 3 or 4 in. of dirt, and the stope holes shot that evening cover their boards with the ore. A good shoveler can fill from 75 to 100 cans a shift with such a layout.

Shovelers in a low heading not using boards are sometimes favored, however, by having the bottom being a flat limestone slab. Where this condition does not exist a piece of sheet iron 3 or 4 ft. square makes a very good shoveling sheet. Tracks are so laid in the drift that a shov-

eler cleans up about 5 ft. on each side of the can. From three to six shovelers work in a drift.

Haulage

On short hauls the famous Missouri mule is the motive power. On long hauls the electric haulage motors of trolley or storage-battery type are used. Shovelers push the loaded can back to the "lay-by," a double track switched at both ends to the main line, which provides storage for the loads on the one end and the empties on the other. When the lay-by is filled with loads the motor or mule takes the train into the shaft, where there is a similar lay-by used in conjunction with hoisting. Fifteen to 20 cans are hauled by motor and 5 or 6 by mule. The shaft lay-by is closed usually within 8 or 10 ft. from the hoisting station, so that little or no time will be lost in getting the loads to the "hook." The heading lay-by is kept as near the working shovelers as conditions permit, and as mining progresses the lay-by is moved up accordingly. Current practice calls for a wider gauge and heavier rail than has been formerly used. Present installations use from 25-lb. to 35-lb. rail on motor lines with 18 to 24-in. gauge. Practically all rolling stock now is equipped with a modern type roller bearing.

Hoisting

The method of hoisting employed is of strictly Joplin origin and belongs peculiarly to this camp alone. Air hoists are gradually being supplanted by geared electric hoists of from 75 to 112 hp., and the latter are now by far in the majority. The "tub runner" at the bottom of the shaft pushes the loaded cans from the lay-by to the "dog house," a small wooden platform upon which the can after being emptied is set. It is usually square in shape, being about 3 ft. on an edge, and is made of one thickness of 8 x 8 floored over with 2 x 12 oak. This platform is so placed that when the loaded can touches its side the can is in the center of the shaft. When cans enter the shaft from two directions at right angles to each other a separate platform or bumping block is so placed behind the car that this can also is centered in the shaft. The tracks in this case are similar to the design of any standard crossover.

The hoist is usually from 50 to 60 ft. above the collar of the shaft, depending upon the height of the mill hopper. The hoisting cable passes over a small sheave wheel which is about 16 ft. above this level, and then down to the "tub hooker." An empty can is lowered with the hoist "open," and when barely out of reach of the tub hooker at the bottom the brakes are applied, slowing up the can smoothly but almost instantly to a barely moving speed. The tub hooker grasps the can at the lower rim, pulls it over so it will not hit the loaded can just pushed in by the tub runner, and the hoisterman then gives enough additional slack to set the can on the dog house. At this instant the tub hooker releases the closed snap hook from the empty with one hand, holds up the bale of the loaded can with the other, and snaps the hook onto it. When the hook is snapped the hoisterman elevates the can with incredible speed to about the level of his eyes, stops it, and closes a counterbalanced door over the shaft which is immediately beneath the suspended can and inclining toward the mill hopper. He next fastens a hook to a ring which is attached to the bottom of the can. The proper slack is then given the can and its contents are dumped on the grizzly. The can is then raised to a vertical position, momentarily steadied and dropped down to the tub hooker to repeat the

"Hooker" snapping a loaded can onto the cable and "tub-runner" waiting to pull back the empty can

Haulage motor bringing in a train of cans to the shaft

Pillar left for roof support

Dumping a hoisting can of dirt

cycle. The foregoing operation takes place within a few seconds, perfect teamwork existing between hooker and hoisterman, no hoisting signals being used. The hoisterman knows partly by feel of the cable and partly by experienced instinct when the empty can has been released from the cable and the loaded one snapped on. While the can is being hoisted the hooker rolls the empty on its lower rim onto the car vacated by the hoisted can. The tub runner then pulls the can away from the shaft with a short hook-rod and then pushes it onto the empty side of the shaft lay-by. In case a loose rock from the shaft wall or a can hits the wall of the shaft, which rarely happens, a "skiddo-bell" is rung by the hoisterman warning the men below of impending danger. In addition to a regular signal bell, shafts are equipped with speaking tubes. This system may seem rather crude considering the fact that no guides or crossheads are used, but years of experience has developed it into such an efficient practice that ordinarily no other method is considered. An idea of the efficiency of a can hoist may be had from the fact that pulling from a depth of 270 ft. 900 cans have been hoisted in eight hours and 800 cans is considered only ordinary. A few of the mines employ skips and they are justifiable only because of the large resources due to consolidation with other properties. Very few accidents have occurred.

Distribution of Supplies

Several large supply firms are located in the district. Frequently used items, such as carbide, machine bolts, pipe fittings, picks, shovels, etc., are housed in a small supply room at the mine office. Each mine usually employs a supply man and a report of all disbursements is made to the superintendent each day. Fuse caps and oil are stored in houses provided for them on the surface. Dynamite is delivered each morning for the day's blasting. This is kept in a magazine underground.

REPORTS ON MINING METHODS AND COSTS IN GREAT DEMAND

Great interest is being manifested throughout the mining industry in the comprehensive series of reports dealing with mining methods and costs at representative mines in the various districts which are being published by the United States Bureau of Mines. These special reports are prepared by engineers at the different mines discussed, who act as consulting engineers of the Bureau of Mines. Approximately 25 reports have so far been issued, and 60 are in preparation or promised. They discuss in brief such matters as the history and geology of the particular district and in detail the methods of exploration, sampling and estimation of tonnage and values; development and mining methods; drilling and blasting practice; underground haulage; percentage of extraction of ore; ventilation methods; and accident-prevention measures. Details of the wage, contract and bonus systems employed are given and mining costs are analyzed in cost per ton of ore and in units of labor, power and supplies.

Among the recent issues in this series are the following:

Information Circular 6186, "Mining Methods and Costs, Alaska Juneau Gold Mining Co., Juneau, Alaska," by P. R. Bradley.

Information Circular 6167, "Mining Practice at Ray Mines, Nevada Consolidated Copper Co., Ray, Arizona," by Robert W. Thomas.

Information Circular 6168, "Mining Methods and Costs at the Magna Mine, Superior, Arizona," by Fred W. Snow.

Information Circular 6169, "Mining Practice and Methods at Inspiration Consolidated Copper Co., Inspiration, Arizona," by Alfred C. Stoddard.

Information Circular 6159, "Method and Cost of Mining at Barr Mine, Tri-State Zinc and Lead District," by Oliver W. Keener.

Information Circular 6174, "Method and Cost of Mining Zinc and Lead at No. 3 Mine, Tri-State District, Crestline, Kansas," by Wm. F. Netzeband.

Information Circular 6170, "Methods of Mining Disseminated Lead Ore at a Mine in the Southeast Missouri District," by C. F. Jackson.

The Idaho SCHOOL of MINES

By HAROLD E. LEE *

Night view of the new Idaho Memorial Gymnasium.

School located in one of premier mining districts of country and in the heart of one of most diversely productive mineral regions of world—Cooperative work with state and federal bureaus—An important factor in mining industry in Idaho

AT THE southwest extremity of the city of Moscow, on a hill overlooking the city and much of the surrounding country, is set the campus of the University of Idaho. To the north lie the Moscow Mountains, a range of beautifully wooded foothills that project from the Coeur d'Alene range with Kamiak Butte to the northwest marking the boundary between Idaho and Washington. Far to the east are seen the foothills of the Bitter Root range while in the foreground lies Paradise hills with their scattered evergreens and patches of prairie.

From the viewpoint of its School of Mines, the scenic attraction is not the most salient feature of the University location. The city of Moscow, in the pan-handle of Idaho, is situated in one of the premier mining districts of the country. It is on the main line of the Union Pacific and Northern Pacific railways and within a two and one-half hour drive from the city of Spokane, Wash. A five-hour drive north will place one in the famous Coeur d'Alene mining district. Here are found mines and mills of the Bunker Hill and Sullivan Mining and Concentrating Company; the Hecla Mining Company; the Federal Mining and Smelting Company; the Hercules Mining Company; and numerous other smaller but attractive enterprises. The diversity of metallurgical operations which may be witnessed and studied is unusual. There is the lead smelter of the Bunker Hill and Sullivan Mining and Concentrating Company with its various departments, including for example a modern roasting plant, a Dwight-Lloyd blast sintering plant, a Cotrell flue dust precipitation plant and of recent date the Tainton electrolytic zinc plant with its novel metallurgical features and production of zinc of unusual purity.

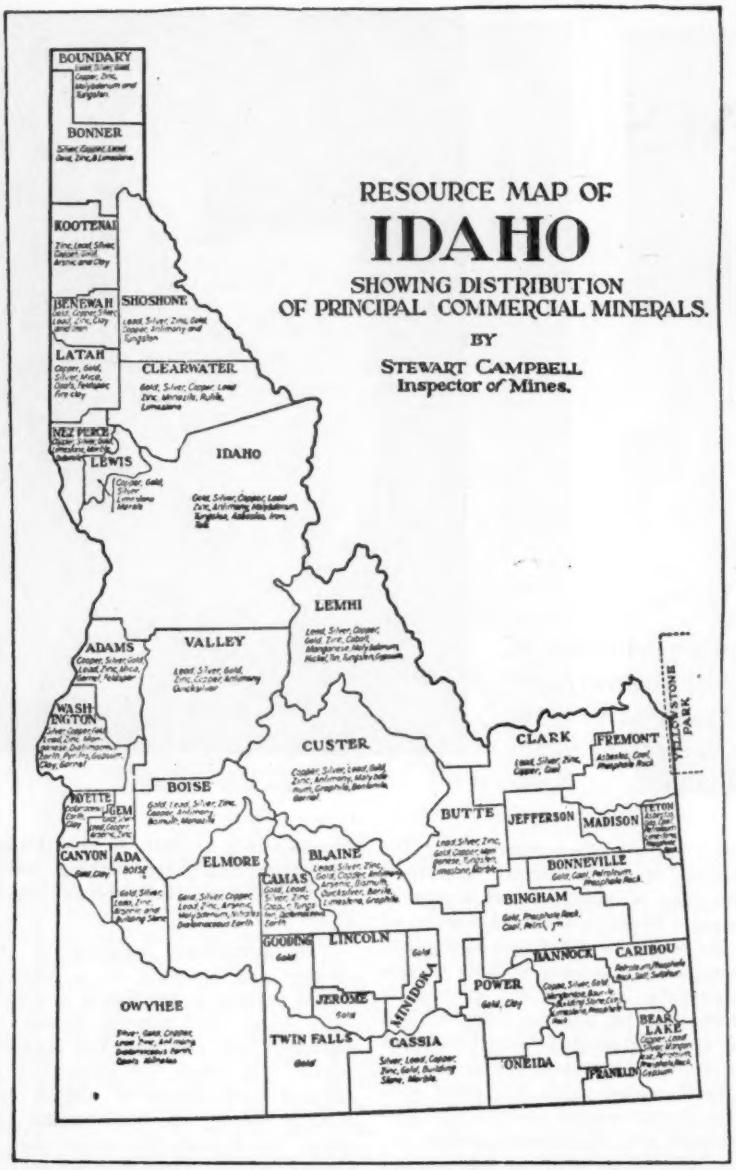
Within a day's drive of the campus is the famous Sullivan lead-zinc mine and differential flotation plant at Kimberly, B. C., and that metallurgical metropolis of the Consolidated Mining and Smelting Company of Canada, Ltd., at Trail, B. C. From this plant are shipped refined lead, zinc, copper, silver, gold, and miscellaneous other metals. Nearly every phase of non-ferrous metallurgy described in books, and much that is not, is practiced at this plant.

In short, the Idaho School of Mines rests in the heart of one of the most diversely productive mineral regions of the world. Within a 300-mile radius are to be found methods of operation from the most modern type to those as old as mining itself. From the great Montana plants of the Anaconda Copper Mining Company with all its modern mining and metallurgical variety; the famous silver, copper, zinc and manganese mines at Butte to gold dredging operations and placer mining both by hand and of the giant hydraulicing and sluice-box type.

The advantages enjoyed by both faculty and students of a School of Mines situated at the hub of a wheel of such concentrated mineral industry are numerous and obvious. The student is within easy reach for illustration and summer employment of almost every form of mining and metallurgical operation. Each year, the senior class, including mining, metallurgical and geological majors, accompanied by the department heads, make a three weeks' inspection tour and study of the plants outlined above. It is of course, impossible for any one to absorb all the technical information available on a trip of this kind. The purpose of this trip is not wholly technical. Its purpose is several fold. Professors and instructors are provided the needed opportunity to discuss with operators their problems of current importance and to learn the trend of developments and processes. This contact is invaluable in our research program and in instructional work. It provides a closer acquaintance and a better understanding between academic people and operators and incidentally it gives the operator a look at his stock of raw material.

An outstanding feature of these senior trips is the interest the operators them-

* Research Fellow in Metallurgy, School of Mines, University of Idaho.



selves take in our visits to their mines and metallurgical plants. Every courtesy is shown and everything done to make this visitation pleasant and profitable. One of the very gratifying results of these trips is the return, usually by the request of this operator, or that one, of our graduates to these plants.

At this stage, it may be instructive to delve into a brief review of Idaho's mining industry as its present rank and future outlook has a direct bearing on the destiny of the School of Mines. Its past is responsible for the present rank and existence of the school.

The state of Idaho contains an area of 83,888 square miles and is divided into 44 counties, 36 of which can be classed as having mineral of commercial importance. In 22 of these counties are producing mines.

In the past, practically all mining has been confined to the five principle metals: lead, silver, gold, zinc, and copper, which are widely distributed throughout the state. The accompanying Resource Map* shows the distribution. In addition to these a great variety of uncommon metals and minerals, many of which have been successfully exploited during the past few years, occur in sufficient extent to be of commercial importance.

The importance of its mineral wealth is shown by the following figures based on the production and exploitation of the five principal metals: lead, silver, gold, zinc and copper.

Total metal production since 1860, over $1,100,000,000.

Average annual production for past 25 years, over $25,500,000.

Average annual expenditure on new mine developments and prospecting, over $4,000,000.

Lead is the most important metal found in Idaho, and, excepting the years 1926 and 1927, this state has always ranked second in the United States in its production. Idaho produces over one-fourth of the total lead mined in this country. It contains the largest lead mine in the United States, that of the Bunker Hill and Sullivan Mining and Concentrating Company at Kellogg. Other important Idaho lead producing mines, in respective rank as to total production in the United States are: Federal Mining & Smelting Company, third; and the Hecla Mining Company, fifth.

Considering the magnitude and character of Idaho's mineral industry, the reader will experience no surprise that from its beginning the University of Idaho has appropriately maintained courses in the technology of the mining profession. In 1889, when the fifteenth session of the Legislature of the Territory of Idaho passed an act establishing the University of Idaho, provision was made for instruction in mining and metallurgy. At first these courses were given, with a maze of other engineering subjects, in the School of Applied Science. Later, as the industry became more technical and gathered momentum, this arrangement was altered. The Commissioner and Board of Education, acting on the recommendation of the president of the University, announced in August, 1917, the creation of a School or College of Mines as an administrative unit of the University. The field of the School of Mines is thus indicated:

"Within this school will be included the work in mining proper, in metallurgy, and in geology; and it shall include the exploitation of the non-metalliferous minerals (except road making materials) as well as that of the precious and useful metals."

In compliance with this instruction, the School of Mines offers courses and curricula leading to degrees of Bachelor of Science in geology, mining, and metallurgy. Graduate work leading to the degree of Master of Science in these respective branches is also offered. The entrance requirements and courses given are similar to those of other good mining schools of the country. Care is taken to revamp courses to keep pace with modern practice. Modern methods are stressed while obsolete practice of merely historical interest is treated in accordance. Students in all three curricula, viz, geology, mining and metallurgy, take the same work in the freshman year. It is thus unnecessary for the student, until the beginning of his sophomore year, to indicate what curriculum he expects to follow.

The policy and attitude of the School of Mines toward the mining professions may best be pictured by quoting a few

* State Mine Inspector's Thirteenth Annual Report.

paragraphs from one of its recent bulletins:

"From the viewpoint of the individual, mining is likely to be regarded as the business of making money out of minerals. From the broader viewpoint of industrial economics, mining is the art of adapting minerals to commercial use, and while we usually associate the production of minerals with the idea of private gain, it is well to recognize that mining must be continued whether the individual gains or loses. If mining is not pursued for personal profit, then it will have to be pursued from public necessity. * * *

"So rapidly is the progress in the arts of mining and ore treatment being made that in one case a process which was practically scoffed at 10 years ago is today treating more than 70,000,000 tons a year. This is flotation concentration. A dozen technically trained men are employed today in the mining industry where one was needed 15 years ago.

"To supply this demand and thus to serve the great mining industry of this state is the prime function of the Idaho School of Mines. Embracing as it does the three cognate lines, of mining geology, by aid of which the ore is found; of mining proper, by aid of which the ore is brought to the surface; and of metallurgy, by aid of which the metal is taken out of the ore, the School of Mines is well fitted to give to the young man contemplating any phase of the mining profession a most thorough foundation in the essentials of his business."

The relation of the School of Mines to the University of which it is a part automatically exerts a strong influence upon the student. Here he meets fellowmen of diverse character and inclinations. He lives and engages in outside activities with future, doctors, lawyers, agriculturists, engineers, statesmen, diplomats, and what-nots. Many of his undergraduate studies place him in classroom association with these varied types; should he be an athlete, he will strive against them in varsity competition and if successful he will strive with them to subdue a common foe. The contacts he makes during his collegiate period will, in future years, prove of great value.

The Administration Building as viewed from north entrance to campus.

He is in the midst of a broadening influence, socially, culturally and scientifically. In this environment he early learns that there is much more to life than mere technical knowledge. The problems of the engineer include humane and social relationships, as well as those purely technical. He must, it is true, have the opportunity to develop the quality of independent thinking and leadership, but he also must know how to create a cooperative attitude among those who are in a position to give practice to his ideas. The University association affords a fine opportunity for this kind of training of young men.

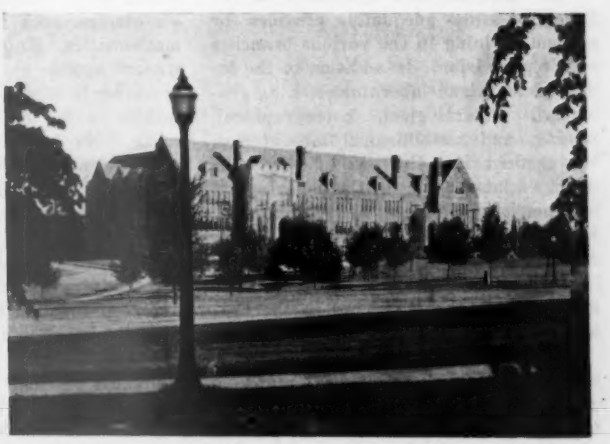
In the faculty of the Idaho School of Mines the scientific attitude is developed to a high degree. This has come about through a program of research which has been so persistent since 1917 that it is looked upon as indispensable in work of the School of Mines.

In Idaho in 1917 there was provided by law a little institution called the Idaho Bureau of Mines and Geology, charged with the responsibility of cooperating with the United States Geological Survey and with the United States Bureau of Mines. For this work the Bureau is appropriated $40,000 biannually, of which $25,000 are expended in cooperation with the United States Geological Survey and the United States Bureau of Mines.

The Bureau of Mines and Geology is the research arm of the School of Mines. The officers include the Dean of the School of Mines, A. W. Fahrenwald, as the executive secretary and director of research; and the Board of Control, which comprises the Governor, H. C. Baldridge; the State Mine Inspector, Stewart Campbell; the professor of Geology, F. B. Laney; and L. E. Hanley, superintendent of the Hecla Mining Company. The research staff includes the professors of mining and metallurgy and the research fellows. Cooperating with this group is the staff of the United States Bureau of Mines field office.

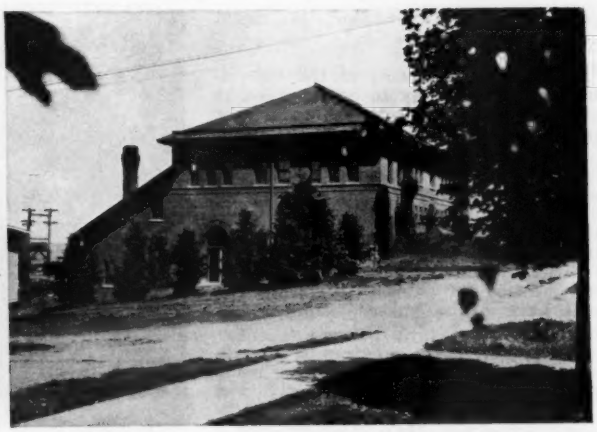
The metallurgical research has for its goal the improvement of metallurgical practice, the prevention of mineral waste and general assistance to operators and engineers. Research methods, involving much painstaking experimentation for

The Engineering Building of the University as it appears from the campus center.



Science Hall, containing class rooms and laboratories for physics and chemistry.

The Geology Building. Within it are located the geological laboratories and offices of the School of Mines.



The Metallurgical Laboratory. In this building are well equipped ore dressing and assaying departments.

the purpose of obtaining facts, are followed. Upon these facts are built a permanent science which makes the "try and miss" method of testing a procedure of last resort. Unusual opportunities for students to come in contact with the highest grade of research in the mineral industry prevail. The metallurgical accomplishments of the School of Mines, under the direction of the United States Bureau of Mines, during the past few years have furnished the advanced students the unusual chance to see and know at first hand some of the most important developments in metallurgy during the past 20 years. On the other hand, the extensive geological investigations which are carried out cooperatively by the Idaho Bureau of Mines and Geology and the United States Geological Survey afford excellent opportunities for advanced students to become familiar with the latest methods of geological field and laboratory work and of preparing geological reports. During the past eight years it has been possible for every student specializing in geology to have at least one summer's work as a field assistant in a party engaged in actual geological field study and mapping.

The facilities and equipment of the School of Mines adequately provides for student training in the various branches of the profession. In addition to the independent school laboratories, i. e., geological, mineralogical, petrographical, mining, and metallurgical laboratories, the student has the use of the well-equipped laboratories of the departments of Chemistry, Physics, and Mechanical, Electrical, and Civil Engineering laboratories as well as opportunity for studies in English, Economics, History, Languages, and other branches in the College of Letters and Science.

So far, this article has presented a somewhat plain description of material qualities and direct advantages possessed by our Mining School. A brief picture of other less material and indirect advantages may prove of interest to the reader. These include the nature of the student's life upon the campus, the school spirit, and the relationship existing between the student and the faculty. These factors have a direct bearing on the student and his attitude toward his school and studies.

In the first place, Moscow is a typical college town. It has an elevation of about 2,700 feet and a climate that is both healthful and inducive to study. The close proximity of mountain streams and forests, abundant with fish and game, provide the student ample opportunity for outdoor life and recreation. Both varsity and intermural competition in sports aid in keeping him physically keen. Social and cultural forms of entertainment also prevail.

The school spirit, characteristic of the Idaho School of Mines (and by this is meant the eagerness and ardor with which the student body attacks their studies and their sincere regard for their school and profession), is not something immediately realized by the incoming freshman. It passes through a period of evolution, gradually developing and reaching a high point with the closing college year. Many of the undergraduate studies, such as chemistry, physics, mathematics, English, etc., carry the student outside the Mining School. His education is of a general nature and his outlook on the mining profession rather vague. As he advances scholastically, more and more of his work is within the School of Mines. His junior year marks his real introduction to the mining field. Here its interests and problems are revealed to him; he obtains a clear vision of the mining industry and experiences a sincere interest in his chosen profession. When he becomes a senior, he finds himself one of a group of young men vitally interested in their school and studies. They attack their problems with eagerness and keen scholastic competition prevails.

Intimate contact exists between the student and faculty in the Idaho School of Mines. This is desirable for instruction and training in a profession experiencing such steady development and progress. In many cases it is necessary for students and instructors to meet on common ground and study together new theories and processes. Students at all times feel at liberty to call on the faculty for aid and advice.

Like other schools, Idaho has its share of celebrities who are outstanding in the mineral industry. For years it has turned out competent men who through their success and leadership have created an ever-growing demand for Idaho graduates. Considering our position, in the center of an area of concentrated mineral industry, it is a small wonder that the school has for the past 10 years had more requests for men to take good positions than it had qualified men to offer. Graduates, through promotion and desire for adventure and travel, have found their way into foreign fields until today we find the Idaho School of Mines well represented throughout the world of mineral industry.

In closing, it may be well to add that the Idaho School of Mines, because of its ideal location in the Northwest, in the center of a mineral industry that is growing rather than declining, will continue to grow. The resources of the state have not yet reached their peak of development. The closing paragraph of a recent Idaho School of Mines bulletin illustrates its position in this connection:

"The School of Mines is at the service of the people of the state and through its cooperative relations with the state and federal bureaus it stands in a unique position to render aid in the development of the state's natural resources. Great as are the developed mineral deposits of the state, it is probable that the undiscovered mineral resources are still greater. To the developing of these untouched reservoirs of public wealth the School of Mines, through education and investigation, pledges itself."

LEGISLATIVE REVIEW

LITTLE HEADWAY made with tariff revision bill—Rate schedules not yet considered—House in recess until November 11—Investigation begun of influences affecting legislation

CONTINUED opposition to the industrial rates in the measure has operated to further delay the tariff revision bill in the Senate. Although that body has given practically exclusive consideration to the measure for the past two months, only a few sections of the bill have been approved and all of the rate schedules remain to be acted upon. The principal action taken was to change the method of acting on reports of the Tariff Commission under the flexible provision. The Senate disregarded the wishes of the President by voting to hereafter have Congress pass on these changes instead of authorizing the President to make advances or decreases in rates to equalize differences in cost of production between the United States and foreign countries on imported articles. Senate leaders are still hopeful of more rapid disposition of the other provisions of the measure in order to secure final action on the bill before the regular session convenes in December.

Interwoven with the tariff bill is a new Congressional investigation ordered by the Senate as to agencies influencing legislation before Congress. This inquiry is being conducted by a sub-committee of the Senate Judiciary Committee and was opened with an investigation as to alleged influences in connection with the pending tariff bill.

As the House has completed all of the legislation it was called upon to pass during the present extra session which began April 15 last, it has decided to continue its three-day recesses until November 11, waiting on the Senate to send over the tariff bill, which when passed by that body will go to conference to adjust the Senate amendments. Congressional leaders desire to dispose of the tariff bill before the December session in order to give other legislation the right of way.

During the past month a number of new bills were introduced, among them measures providing for a station of the Bureau of Mines at New Brunswick, N. J.; for an additional extension of two years on oil and gas prospects; and for regulation of air commerce by the Interstate Commerce Commission.

The following is a summary of bills before Congress during the past month:

H. R. 4500. Mr. Hoffman (Rep., N. J.). This bill proposes to appropriate $250,000 for the construction of a plant at New Brunswick, N. J., for investigations by the Bureau of Mines. Mines and Mining.

S. 1752. Mr. Warren (Rep., Wyo.) and H. R. 4532, Mr. Carter (Rep., Wyo.). These bills propose to authorize a two-year extension of oil and gas prospecting permits in cases where the holders have been unable to begin drilling operations or to drill wells of the depth and within the time required, or have failed to discover oil or gas, and desire to prosecute further exploration. Public Lands.

S. J. Res. 75. Mr. Frazier (Rep., N. Dak.). This resolution provides that every Member of Congress and every government employe receiving a salary of $3,000 or more per year shall file with the Federal Trade Commission before March 31, 1930, a statement of the amount of stocks, bonds or other investments owned within the preceding two years in any mining, oil, or other corporation. The resolution is based on the fact that such investment ownership might influence Federal officials in their official attitudes. Finance.

H. R. 4192. Mr. French (Rep., Idaho). This bill authorizes the coinage of 50-cent pieces in commemoration of the 125th anniversary of the Lewis and Clark expedition. Coinage.

PUBLIC LANDS

H. R. 4187. Mr. French (Rep., Idaho). This bill is designed to promote the highest general use of the public domain, prevent soil errosion, protect national watersheds for the conservation of water, prevent floods, encourage the growth of timber and forage plants and to stabilize the livestock industry. The law would be administered by the Interior Department which would issue grazing permits for not more than 10 years' duration. Provision is made for the use of coal, timber and other deposits on the lands by miners, prospectors for minerals and settlers, for use in mining, prospecting and other domestic purposes. The bill would not restrict the use of water on public lands controlled by grazing permits for mining, milling, domestic or irrigation purposes, nor would it prevent ingress or egress over the public lands held by the permittee for prospecting, locating, developing, entering, leasing, or patenting the mineral resources of such land under laws applyin thereto. Public Lands.

H. R. 4188. Mr. French (Rep., Idaho). This bill proposes to withhold timber lands from sale under the timber and stone act. Public Lands.

S. 1695. Mr. Hayden (Dem., Ariz.). This bill authorizes the Government to exchange public land in Arizona for private lands in Coconino or Sitgreaves National Forests in Arizona. Where mineral reservations are made in lands conveyed by the Government it shall be stipulated that they may be entered and mined by payment to the owner of the surface for damages that may be caused to improvements thereon. Public Lands.

S. Res. 124. Mr. Wagner (Dem., N. Y.). This resolution authorizes the Federal Trade Commission and Federal Power Commission to turn over to a commission of the State of New York such data obtained in their investigations as may pertain to the regulation of utilities.

S. 1707. Mr. Blease (Dem., S. C.). This bill proposes to amend the transportation act by providing that the right of the Interstate Commerce Commission to prescribe minimum rates shall not prevent railroads, when they can do so, from making rates competitive between shippers served by them and shippers in other sections. Interstate Commerce.

TRANSPORTATION

H. R. 4288. Mr. Denison (Rep., Ill.). This bill provides that after January 1, 1932, it shall be unlawful for railroads to use in passenger trains cars of other than steel or steel underframe construction. After 60 days from approval of the bill it would be unlawful for railroads to use wooden cars between steel cars in the passenger service. Interstate Commerce.

S. 1853. Mr. Smith (Dem., S. C.). This bill proposes to remove the authority of the Interstate Commerce Commission over the construction of new lines of railroad or extensions of existing lines wholly within a State, if the State requires the rail- (*Continued on page* 894)

V 15 11 1 NOV 29 XU

METALS

GUY N. BJORGE
Editor

Practical Operating Problems of the Metal Mining Industry

Phelps Dodge Corporation's New LEAD SMELTER

By J. OWEN AMBLER *

Modern automatic ore sampling and crushing plant designed so that capacity may be readily increased—Special care taken to prevent poisoning — Detailed description of main units of plant

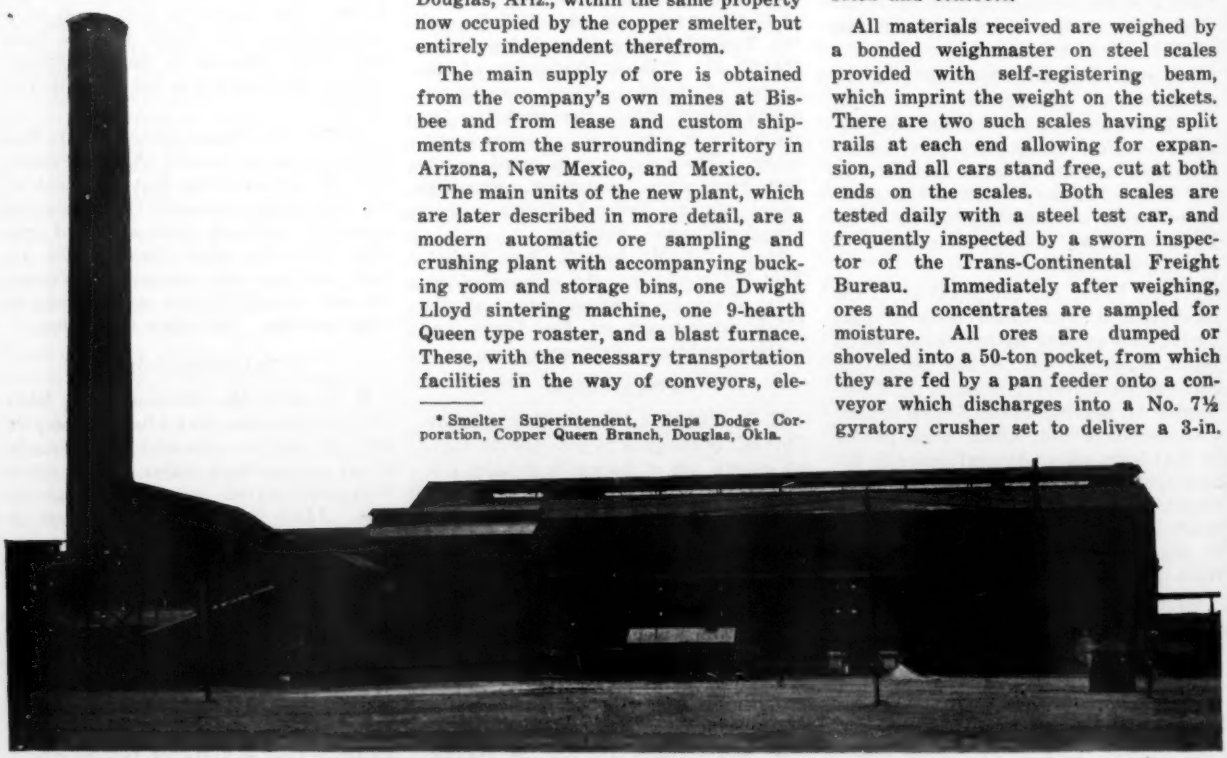
THE new lead smelter of the Copper Queen Branch of Phelps Dodge Corporation is located at Douglas, Ariz., within the same property now occupied by the copper smelter, but entirely independent therefrom.

The main supply of ore is obtained from the company's own mines at Bisbee and from lease and custom shipments from the surrounding territory in Arizona, New Mexico, and Mexico.

The main units of the new plant, which are later described in more detail, are a modern automatic ore sampling and crushing plant with accompanying bucking room and storage bins, one Dwight Lloyd sintering machine, one 9-hearth Queen type roaster, and a blast furnace. These, with the necessary transportation facilities in the way of conveyors, elevators, cars for handling ores, slag, matte, bullion and reverts, the necessary lead kettles and casting machine for drossing and casting lead, and flues, dust chamber, bag house and stack make up the principal equipment (of the plant, which is electrically driven throughout and substantially) constructed of steel, brick and concrete.

All materials received are weighed by a bonded weighmaster on steel scales provided with self-registering beam, which imprint the weight on the tickets. There are two such scales having split rails at each end allowing for expansion, and all cars stand free, cut at both ends on the scales. Both scales are tested daily with a steel test car, and frequently inspected by a sworn inspector of the Trans-Continental Freight Bureau. Immediately after weighing, ores and concentrates are sampled for moisture. All ores are dumped or shoveled into a 50-ton pocket, from which they are fed by a pan feeder onto a conveyor which discharges into a No. 7½ gyratory crusher set to deliver a 3-in.

* Smelter Superintendent, Phelps Dodge Corporation, Copper Queen Branch, Douglas, Okla.

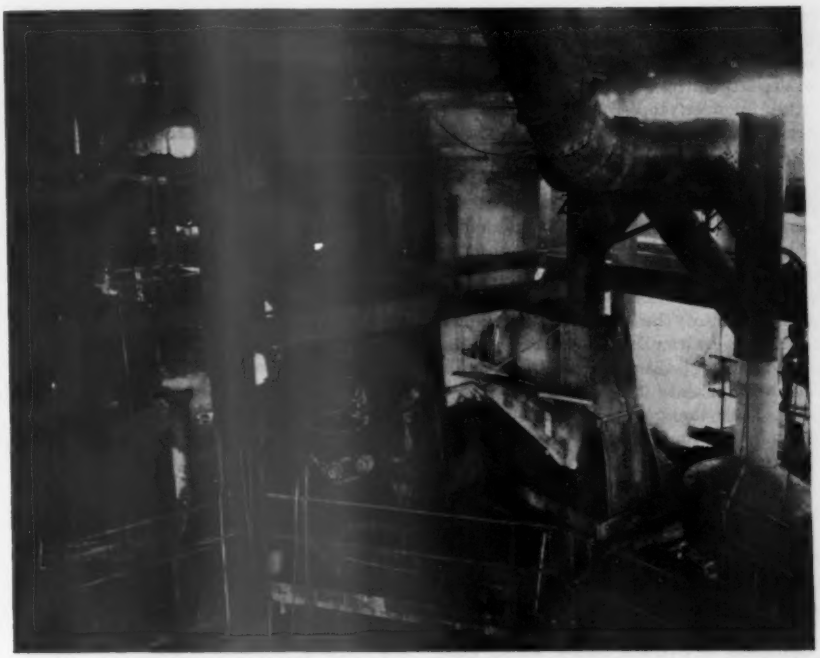


General view of Lead Plant Building

product. The crushed material is carried to the top of the sample mill by a bucket elevator, and passes over a 60-in. diameter Snyder sampler which cuts out automatically 10 percent of the stream, which is the main sample. This 10 percent passes over a shaking feeder, through Telsmith crusher set to 11/16-in. to a 42-in. Snyder sampler, where a second 10 percent cut of the sample is made. The sample, now 1 percent of the original ore, passes over a shaking feeder to a set of 12 x 24-in. rolls set to ¼-in., after which it goes through a riffle sampler, each unit of which cuts the sample in two, and so arranged that the final sample is either ½, ¼, ⅛ or 1/16 of the 1 percent cut. This final automatic sample is in duplicate, one sample being delivered into a container which is taken to the bucking room for final treatment, and the other being sacked and held for 30 days or until all assay results are agreed upon.

If the ore is oxidized, the rejects from the first two samples join and pass over an electrically vibrated screen, the oversize of which drops to a conveyor discharging onto a shuttle conveyor above the coarse ore bins, where it is bedded with other similar ores, the storage capacity of these bins being about 1,500 tons, consisting usually of three beds of 500 tons each. The undersize from the screen, material running under ¼-in. in size is discharged onto the conveyor leading to the fine ore bins, upon which is also discharged the reject from the riffle sampler. If the ore is a sulphide, the oversize from the screen is delivered to a Symons disc crusher set to ¼-in., and both the crushed product and screen undersize discharge to the conveyor leading to the bins for fines. This conveyor is equipped with a traveling bedding tripper, and the fines are bedded in these bins. A short cross conveyor is also installed to provide for discharging material back into railroad cars in case it may need to go to stock piles or bins.

Concentrate received is shoveled from cars into a small pocket, each tenth shovel being reserved for a sample. This tenth shovel sample is piled in the car and a second tenth cut taken in the same manner, giving a 1 percent sample of the original lot, which is taken to the bucking room for subsequent treatment. The reject is discharged from the pocket by a screw feeder onto the conveyor leading to the fine ore bins, where like the fine ores it is bedded in mixes of the correct analysis for subsequent treatment. A pocket is also provided above the conveyor for handling fine dust, bag house fumes, and other materials which go to the fine ore bins, and the crushing plant will also be used for crushing matte, sinter and other plant products as needed.



Interior view showing end of lead blast furnace

Flux if coarse is also handled in the crushing plant, being delivered to a section of the coarse ore bins separate from the ore mixes. If already crushed it is hand sampled and dumped or shoveled into a 50-ton pocket alongside the ore pocket, from which it is discharged by pan feeder onto the belts leading to the bins above the blast furnace. Coke is handled through this same pocket, but may be first dumped into storage bins available at the old copper blast furnace plant, from which bins it is reclaimed into small charge cars which dump into the coke pocket.

The bucking room to which all samples of new material, as well as samples of plant products such as matte, slag, bullion, flue dust, bag house dust, etc., are delivered is located in a separate brick building just outside the sampling plant, and is equipped with an electric dryer, pulverizing mills, bucking boards, sample mixers and cutters and other equipments needed for preparing the final samples. Metallics, or any material, which will not go through the final screen is sent to the laboratory with the pulp for assay. A room is also provided in this building for the Government inspector, under whose direction all bonded shipments are handled, and this building as well as the weighing, moisture sampling, and sample mill itself are at all times open for inspection by shippers or their representatives.

The sample mill is arranged for thorough and expeditious cleaning after each lot of ore is run, and special arrangements have been made for handling smaller than carload lots through the sampler. It is equipped with a dust collecting system which keeps the building free from dust, promoting cleanliness, and health of the men employed in this work.

The correct mixing of the various constituents in the coarse and fine mixes must be very carefully done to obtain good smelting results. Conveyors run in tunnels underneath these two sets of bins, and the mixes are carefully discharged onto these conveyors in a manner to prevent segregation. As an additional precaution a Steadman disintegrator is provided on the fine side, which breaks up any lumpy flotation concentrate and makes a more uniform and thorough mix. The coarse ore mix, fine ore mix, flux, coke, etc., all discharge onto an underground reclaiming conveyor, being, of course, handled separately, which delivers to a bucket elevator taking the material to the top of the smelter building proper. By a system of conveyors equipped with trippers each material is delivered to its proper bin, that for the fine mix being located on the east side of the building above the Dwight Lloyd sintering machine, while the other constituents of the charge are delivered to one of the six bins above the blast furnace.

The storage bin for fine mix above the Dwight Lloyd machine is built with partitions part way down the bin to lessen segregation, and discharges onto a circular revolving distributing plate, from which the material is discharged by a set of plows into an oscillating

feeder box. This feeder distributes a layer of charge, about 4-in. deep, on the pallets of the machine, the coarse constituents forming a grate dressing with the fines on top. The machine itself consists of a series of pallets in the bottom of which is a grating on which the charge rests. These pallets form an endless chain running on rollers at each end, and are moved over a suction box by a sprocket wheel, the top of the charge being ignited by an oil flame just before the suction box is reached, and the speed of the machine so regulated that the ignition of the charge proceeds down through the material on the pallets at such a rate that sintering is completed as the pallets leave the suction box. The pallet then discharges its load, and moves under the suction box to be again charged with material. The sintered cake drops into a small hopper feeding a skip which elevates the sinter to one of the six bins on the west side of the building used for storage or blast furnace charge, or in case double sintering is necessary can be discharged into cars on a track below, which carry it back to the crushing plant.

The constituents of the blast furnace charge, namely, coarse ore mix, sintered fine mix, flux in the form of limerock or iron ore, coke and reverts are discharged from the six bins by pan feeders, closely regulated and under control of the operator as to speed, into a weigh car, each constituent of the 8,000-pound charge being weighed to the nearest 10 pounds. This electrically driven charge car runs over tracks above the top of the blast furnace, into which it is discharged after opening the doors on top of furnace shaft. Scrap iron, dross from lead kettles, etc., are weighed on a platform scale situated on the feed floor, and charged direct into the furnace.

The blast furnace is of the usual type used in lead smeltering, measuring 48 in. x 192 in. at tuyeres and 24 ft. 3 in. from center of tuyeres to feed floor. It is water-jacketed from top of crucible to a point 4 ft. 9 in. above tuyeres or 6 ft. above crucible, above which point it is built of brick. The gases are taken off horizontally below the feed floor. On the charge smelted this furnace has a capacity of 250 to 300 tons per day. The crucible at the bottom of the furnace forms a lead well for collection of the molten lead, which is periodically tapped from the side of the furnace into small wheeled pots and dumped into the lead kettles, the slag and matte produced being also periodically tapped through a breast jacket at one end of the furnace. The stream of matte and slag discharges into two settlers in series, from which matte and any entrained lead are tapped into matte pans, the overflow slag discharging into pots which are hauled to the dump. The matte pans after cooling are discharged and broken up for resmelting.

The two kettles into which the lead from the furnace crucible is poured hold about 50 tons each, and are supported on a concrete cylinder shaped foundation, lined with fire brick and insulating brick, and so arranged that the kettles can be heated by an oil flame. Air is blown into the impure lead and a large part of the impurities contained are oxidized and rise to the surface as dross, which is skimmed off and allowed to drain in a small kettle with perforated bottom. After draining, the dross is resmelted in the blast furnace, while the partially purified lead is siphoned off into moulds, making pigs weighing about 95 pounds, which are loaded into railroad cars for shipment to the refinery. The refinery removes the remaining impurities and separates the gold and silver contained.

The gases from the blast furnace and Dwight Lloyd machine, together with the gas and fume collected from above the settlers, matte pans, lead wells, etc., all of which are hooded to prevent escape of lead laden gas, pass through a flue to a large dust chamber, and thence through a flue system to the fans which force the gas through the bag house, the cleaned gases going to the stack. Dust from the flues and chamber is reclaimed by gravity into cars which deliver to the conveyor leading to the fine mix bins. The bag house is a brick-steel-concrete structure, divided into eight sections for convenient operation and maintenance, in which are hung 1,008 bags of pure wool, especially woven for this service. The arrangement is such that the gas can be cut off from any section and the bags thoroughly shaken by mechanical means to dislodge the collected fume. The fume drops to a concrete floor, and when it has accumulated to a depth of approximately 3 ft. is ignited, the resulting soft clinker being reclaimed by hand into cars which deliver it to the conveyor over fine ore mixes.

The matte produced, as noted, is broken through a grizzly into railroad cars and taken to the crushing plant. At present the matte produced averages 30 to 35 percent copper and 9 to 12 percent lead, and this is shipped direct to copper department converters. When matte of lower grade in copper is made, it is accumulated until sufficient is on hand for a concentration run, the regular ore charge being taken off the blast furnace while concentration run is in progress. For such a concentration run the matte is crushed to approximately ¼-in., delivered to bins above a 9-hearth Queen roaster and calcined to eliminate a large part of the sulphur contained. The calcined matte is sprayed with water and delivered to special compartments of the fine mix bins, where it is bedded with the requisite fine ores. This mixture is then sintered and the sinter is smelted in the blast furnace with the requisite fluxes, ores, etc. The products are the same as in an ore run, except that the matte produced is high grade enough in copper for shipment to the copper converting plant.

For some time after starting up, the 30 to 35 percent copper matte was treated in a small insulated converter, 5 ft. in diameter and 5 ft. long and having a capacity for treatment of 25 to 30 tons of matte per day. The converting was carried forward to the white metal stage, at which point a large proportion of the lead contained had been fumed, this fume being collected in the bag house and the white metal sent to copper converters. The operation, however, was on too small a scale to be economical, and such matte is now treated at copper converters.

The presence of certain elements that are frequently contained in lead ores makes the operation more expensive and complex, the most common of these being zinc, copper, arsenic, antimony, cadmium and bismuth. In the smelting operation practically all the zinc must finally be eliminated as an oxide in the slag, and in addition when present beyond a certain small percentage it necessitates the use of scrap iron on the blast furnace charge to prevent the formation of mushy slags, results in increased metal losses, causes additional scaffolding in the furnace shaft, and in general is an undesirable element. A certain percentage of the copper contained is recovered, but its presence tends to raise the amount of lead carried away by the slag, and makes the operation more complex by necessitating roasting, sintering and concentration of the matte produced, together with the converting of the final lead copper matte. Arsenic, antimony and cadmium tend to concentrate in the bag house dust, and also to foul the base bullion produced, require special treatment to eliminate them from the system, and increase the drossing cost and refinery cost of lead bullion. Bismuth is particularly objectionable since it tends to collect in the lead bullion and greatly increases the refining cost on account of the difficulty of separating it at that point.

The lead plant was designed by Mr. A. G. McGregor, engineer, in collaboration with the operating staff of the Copper Queen Branch and was constructed by the Dwight P. Robinson Construction Company in remarkably good time. It is designed so that the capacity can be readily increased, and special care has been taken by hooding all apparatus, installing special change rooms, lunch rooms, etc., to prevent any possibility of poisoning employes by lead fumes or dust.

RECENT DEVELOPMENTS in MILLING PRACTICE

(from page 852)

some have considered replacing this with a pump. This replacement is not likely to become general in the near future.

In some table rooms glass lining for launders has been introduced in the last two years and proved very satisfactory, especially where head room and slope are at a premium and where corrosive water is encountered. Its initial cost is less than cast or steel spouting and its life is longer.

Many other improvements and changes have been made in the table room so that now thorough desliming is commonplace and regrinding of most of the small chats is practiced.

Flotation Department

The first efforts at flotation in this district were in 1915 to 1917, but the results were indifferent. In the succeeding years several companies put in a few machines and floated small amounts of mineral. It was not until 1924 that the district gave real serious consideration to this matter. Two principal facts caused the district to embrace flotation about this time. More slime was being isolated from the coarser material and more chats were being ground so that there was a justifiable amount of feed to the flotation unit. The present selective flotation reagents appeared about this time, and hence galena and blende could be separated reasonably well. Other facts also contributed to the acceptance of flotation by the district. Flotation royalties in 1922 were about $4.80 per ton concentrate; these have gradually decreased until today they are almost negligible. Until 1924 no filters for flotation concentrates were in use; usually bulk flotation of galena and blende was practiced and the froth was tabled and the two concentrates caught in small settling boxes. Nearly 50 percent of both the minerals floated was lost.

The present practice in the flotation department is about as follows: All of the overflows from the table department pass to a thickener (usually 40 ft. to 60 ft. diameter; the tendency is toward larger thickeners) whose overflow goes to a settling pond for reclaiming of water and whose discharge is taken by a diaphragm pump and sent to an elevator or to another pump such as a Wilfley. Many flotation plants now have no elevators and rely entirely on pumps. The flotation pulp may then or may not receive some preliminary agitation or conditioning before passing to the lead machine. Quite a typical plant consists of three or four Butchart 4-cell machines; one and occasionally two machines are devoted to the lead circuit. Both in the lead and the zinc circuits the cleaner-rougher system is employed—that is, the finished froth is made at the head of the respective circuit and the subsequent leaner froth is returned to the head of the circuit. The lead froth is tabled usually for ultimate recovery of mineral; this results in a high-grade concentrate, 70 to 80 percent Pb. but about 50 percent of the lead floated is lost. In a very few instances the grade of lead froth is high enough (above 40 percent Pb.) so that it is filtered and converted into a salable product; any product with a lesser lead content has virtually no sale.

After the lead has been floated, the pulp passes to the zinc machines, two or three in number. Occasionally the zinc froths are given a final treatment in a cleaner machine. In most plants the zinc froth is sent direct to the filter, but in a few is given preliminary thickening.

The American disc filter has proved very popular and satisfactory and is used in most mills; very few filters of the Portland or Oliver types are used.

The Butchart flotation machine is used in more than 90 percent of the mills. Pneumatic machines have been tested considerably in the last three years but, except for one company, they have not been accepted. The mechanical agitation type of machine as represented by the Fahrenwald or Denver Sub-A has made its entrance into the district in the last year. It has many advantageous features and doubtless a number of these machines will be installed.

Five years ago flotation accounted for about 8 percent of the zinc concentrate production in the mills which employed this process; today about 20 percent of the zinc production is by this means. As more slime is removed from the coarser material and as more chats are reground this production will rise very probably to 30 percent in the next three years.

Two years ago the flotation concentrate in this district was a drug on the market; the smelter man did not want it as he did not have proper equipment for handling it. Today the retort smelter is equipped with multiple-hearth furnaces and sintering machines and is demanding flotation concentrates. The new electrolytic zinc plant at East St. Louis will seek to fill all of its requirements with these concentrates. Today the flotation bins of this district are swept clean and the demand is in considerable excess of the supply. When the smelter did not want these concentrates they were sold at a price $3 per ton below the base for gravity concentrates; that penalty still exists but the probability is that in the very near future it will be adjusted and, if not wholly, partly eliminated.

How the insistent demand by the smelters for flotation concentrates will influence the milling procedure in this district is an interesting picture to contemplate. The flotation tailing is usually the lowest in the whole concentrating plant; it will approximate 1.0 percent blende. The separation of lead and zinc is not nearly as positive by flotation as on jigs and tables. Lead flotation to date has not been satisfactory, but there are promising possibilities for improvement. The initial cost of flotation equipment per ton of material treated is much higher than for jig and table machinery. The operating milling cost is, of course, higher than in the gravity departments. The gangue in this district is harder to grind than in most mining fields. The 10-hour shift per day is the prevalent period of operation and this is a serious factor against securing the most efficient flotation operation. These are some of the factors that enter the picture and will determine how great a part of the jig products can be reground and floated.

But almost without question a greater proportion of the concentrates will be produced by flotation as time passes. Some have considered an all-flotation mill for these ores, but such procedure if practiced will certainly not become general for quite a few years.

In this discussion, mills for re-treating old tailing piles have not been considered, as the milling procedure is generally much the same as for mine-run of ore. In the past three years a great many of the tailing piles made previous to that time have been re-milled, yielding 1.0 to 2.0 recovery (tons concentrates per 100 tons milled). Usually more than 50 percent of the tailing mill production has been by flotation. No tailing piles made in the past three years have been re-milled, and as most of the tailing piles regarded as profitable to re-treat are being re-milled, very few tailing re-treatment projects will be initiated in the future until the milling practice has been improved much beyond what is used today or until metal prices have risen possibly as much as 50 percent.

The very probable tendencies in the Tri-State mills in the immediate future will be: separate crushing departments to prepare a uniform feed and provide the desired quantity of feed per unit of time to the concentrator. Jigging departments equipped with steel jigs, thorough desliming devices, and more chat drawing equipment. Ball and rod mills to re-grind larger quantities of chat products. Table departments may be eliminated in some cases but when they are retained they will be provided with a well-deslimed and classified feed. The flotation department will be improved and equipped to handle more tonnage. Flotation of coarser material will probably come soon; the separation between lead and zinc will be made sharper and the flotation and recovery of galena will be much improved. The demand by the smelters for more and more flotation concentrates may cause much greater changes in Tri-State milling than the district anticipates today.

SAFETY and INDUSTRIAL RELATIONS at EAGLE-PICHER

(*from page 878*)

tional bonus of $5. Also a bonus of $10 is given to the foreman having the least number of days lost, of those mines having one or more lost-time accidents. Thus the foreman having a lost-time accident has an incentive to keep in the race, as he may win the $10 bonus. Much has been said for and against a bonus for good accident records. The company's experience shows that the bonus pays. The first year the Eagle-Picher paid a bonus while its subsidiary company did not. At the end of that year it was found that the company not paying the bonus had 50 percent more lost-time accidents per thousand man-shifts than the Eagle-Picher Company. The second year bonuses were paid by the subsidiary company, and its lost-time accidents were immediately reduced. Previous to the bonus system, the foreman took very little interest in an accident after it occurred. In other words, he knew that it was his business to prevent accidents, but after the accident occurred he then considered everything was up to the claim department. With the bonus system in effect, the foreman usually accompanies even the slightly injured to the doctor. He waits until the injured is treated and then, with the doctor's permission, hauls the man back to his job. Many a lost-time accident is avoided by this personal interest of the foreman.

There has been a gradual reduction in both the number of accidents and the severity during the past four years. In 1926 the accidents per thousand man-shifts were 0.71. The accidents have been reduced each year, and the first six months of 1929 show an accident record of about two-thirds that of 1926. The reduction in severity, which is really the more important factor, has been more marked. In 1926 the days lost per thousand man-shifts in all the company's mines was 59.8. In 1927 the severity was reduced 41 percent to 36.6. In 1928 the severity was reduced 64 percent under the previous year to 13.1. In the first half of 1929 the severity was 10.7, or only 18 percent of that of 1926.

The company maintains a hospital with two competent doctors. This hospital is so located that it is within 4 or 5 miles of each of the company's mines. In case of an accident, the injured is usually in the hospital under the doctor's care in less than 30 minutes after he is injured. An order is not required to receive treatment for an injury. All red tape is cut out, in order that the employe may receive the earliest possible medical attention. In slight injuries the men often go unaccompanied to the doctor. They are treated first and then asked where the accident occurred. There are a few cases when men not employed by the company take advantage of a free treatment. However, these cases are rare, and are of not enough importance to warrant the requirement of an order for treatment. All new employes are required to have a complete physical examination. Also all the regular employes are required to have this same examination yearly. There is no charge for these examinations. The company is exceedingly liberal in acting on the information furnished in this examination. No men are barred except those afflicted with contagious diseases, ruptures, very high blood pressure, or exceedingly poor eyesight. With old employes the company goes further and helps to correct the above defects, if possible. Free treatment is provided for the two common private diseases, and the man is allowed to return to work as soon as the doctor advises that it is safe for him to do so. However, the free treatment is continued until a permanent cure results.

With the above fair and liberal treatment of its employes, there has always been the friendliest feeling between the company and its workmen. A wage scale was established by the company whereby the men's wages are raised or lowered as the price of ore fluctuates. With each $5 raise or reduction in the price per ton of zinc ore, the wages are raised or lowered 25 cents per day. However, on the last reduction in the price of ore below the wage scale base the company voluntarily made no reduction in wages. It was felt that such a reduction at that time would work a hardship on the men. The company feels justly proud that there has never been a strike in any of its mines in its history. Still more remarkable is the fact that not even a small group of miners have ever asked for either a raise in wages or a change in working conditions.

LEGISLATIVE REVIEW

(*from page 889*)

road to secure authority from it for such construction.

Interstate Commerce.

H. R. 4442. Mr. Sutherland (Rep., Alaska); and S. 1811, Mr. McNary (Rep., Oreg.). These bills propose a study regarding the construction of a highway to connect the northwestern part of the United States with British Columbia, Yukon Territory and Alaska in cooperation with Canada. Roads and Agriculture.

S. Res. 128. Mr. Walsh (Dem., Mass.). This resolution provides for an investigation and report within a year by the Department of Commerce as to investment of American capital abroad, especially in Europe, and particularly by American corporations engaged in manufacturing in the United States. Passed by the Senate.

H. R. 4533. Mr. Dallinger (Rep., Mass.). This bill proposes to regulate the activities of legislative counsel and agents before the House or its committees. The bill provides for the registration of such interests with the Clerk of the House and the filing of a statement of their expenses in promoting or opposing legislation. The House would be authorized to disbar any person from acting as legislative counsel or agent after a hearing before one of its committees. Judiciary.

SIGNALLING FROM MINE CAGES

Signalling the hoisting engineer at shaft or slope mines is an important feature in safe and efficient haulage or hoisting and is a feature rarely considered in mine-hoisting installations, says the Bureau of Mines. There should be at least two, preferably three, independent signalling systems, and there should by all means be a signalling system operable from cages whether moving or at rest. Such a system may be fully as economical as the usual systems operable only from the levels, and in some instances the signalling from the cage can be made more economical than a similar system of level signalling. The outstanding feature of the method allowing of signalling from the cage is its greater safety; however, the greater and more positive control of hoisting may easily effect economies that will offset the cost of the installation.

The cost is trivial when prevention of accidents or the saving of human life is considered. The cost of one severe accident or of one life lost through failure to provide a signal on the cage will more than equal, in cold cash expended in compensation, the cost of the installation or its maintenance and operation for several years. Many instances could be cited of lives lost or jeopardized, particularly in coal mines, by lowering men into water-filled sumps. Lack of ability to signal from the moving cage during ordinary working time has resulted in numerous accidents, many resulting in death and many others in heavy destruction of property. The ability to signal from a moving cage during shaft fires in metal mines is a safety feature which in itself should require its universal use.

There is no doubt that the many definite safety features involved in the ability to signal from moving cages should appeal alike to coal and metal mine operators wherever men are transported in vertical or inclined shafts.

A description of methods used in Utah for signalling mine hoists from mining cages is given in Information Circular 6161, "Signalling from Cages at Rest or in Motion," by D. J. Parker and R. I. C. Manning, recently issued by the Bureau of Mines.

Mechanization Report No. 29-4

GATHERING HAULAGE METHODS With Mechanical Loading

Curves and graphs showing relation of productive time to time required for gathering haulage and moving the loading operation from one room to another

By G. B. SOUTHWARD

THE preceding mechanization report (No. 29-3) discussed the haulage factor in a mechanical loading operation and particularly how the productive capacity of the machine was affected by the delays incidental to single car placement at the working face. The present report will discuss how this capacity is further affected by the delays due to trip changes, and by the time lost in moving the loading operation from one working place to another.

The main purpose in showing and discussing these different sources of haulage delays and their effect on the cost of the mechanical loading operation is to consider the several methods of gathering which have been designed to reduce these losses. The principal source of delay in room and pillar mining, as the following curves show, is caused by the single car change and several methods are now being used at various mines to reduce this loss. Mine cars of larger capacity are being installed and a material decrease in the time loss is brought about by increasing the size of the mine cars. However, this method is efficient only up to certain limits and beyond that point a further increase in the production should be made by decreasing the time for changing single cars or by reducing or eliminating the time lost in the trip changes. The result of decreasing the time of the car changes was shown in Figure 5 of Report No. 29-3, and the effect of eliminating the trip changes is shown in the curves and graphs of this report.

Several methods are now used to reduce these time losses. The first is to have two gathering units with the loading machine. This is employed with both mechanical and live stock haulage and while no set rule has yet been established, two gathering locomotives are more commonly used with a single track in the rooms and live stock haulage where the rooms have double track. Where double track in the rooms is practicable it might appear that this would provide for continuous loading but while it is true that an empty car can be placed on the second track while the car on the first track is being loaded, there is usually some delay for shifting the loading machine to reach into the second car.

Another method is to provide a small storage side track in each room. This is moved forward as the room advances so that a car supply always will be close to the working face. A third method is to lay connecting switches through the breakthroughs to the adjoining rooms. This provides convenient switching for the loads and empties by using the track in either or both of the adjoining rooms for empty and load storage. The switches are moved up to the breakthrough near the face as the rooms advance to reduce the distance of shifting.

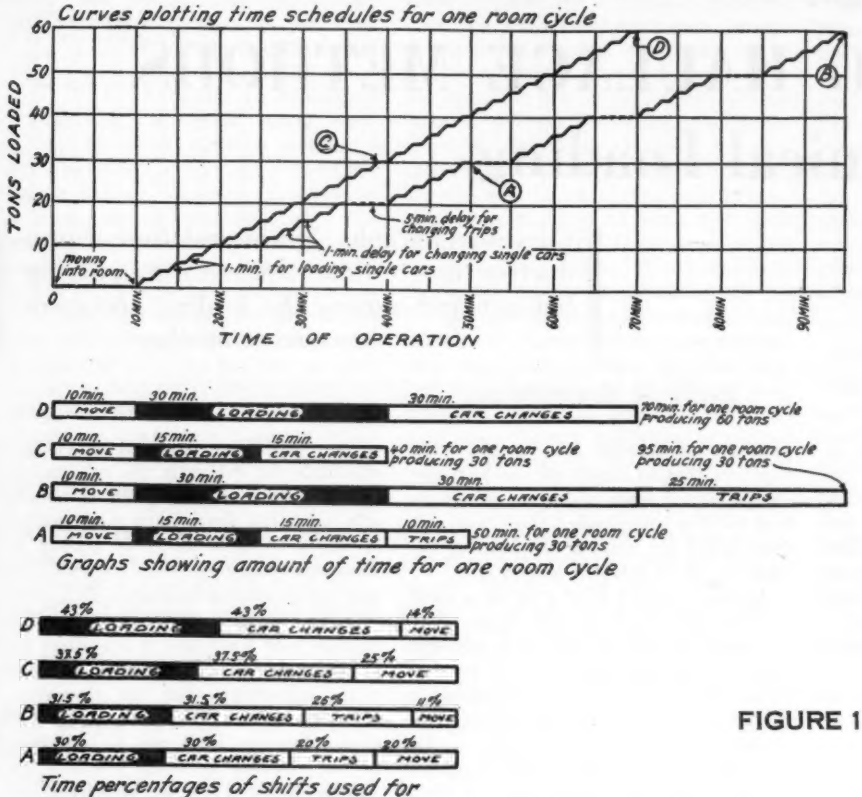
A fourth method is still in the experimental stage or at least has not yet been widely adopted. This consists in having an auxiliary machine, usually some type of conveyor, to transport the coal from the loading unit to the trip of mine cars. Several devices designed for this purpose are now under development and have promise of becoming practicable and standard operating equipment. These will be covered in later reports after their use has become more firmly established.

Where the loading machine unit is served by one gathering locomotive it is frequently customary for the motor to start with a trip of several cars and shift out the single cars as loaded. When the entire trip has been loaded the locomotive must then haul these to a side track and pick up another trip of empties. This method of trip changing, of course, involves some delay and the amount of delay depends upon the distance from the working place to the side track. In some mines the gathering side tracks are so arranged as to reduce this time to a minimum or negligible figure; in others the time lost from this source is quite appreciable.

The gathering and switching methods mentioned in the preceding paragraphs of this report are designed to reduce or eliminate the delays in the trip changes but the time saving which is actually effected in the mines using these methods is really brought about by proper and close scheduling between the main line and the gathering haulage. This scheduling is dependent on the capacity of the storage side track and it is obvious that a small capacity side track requires much closer scheduling than one of a larger capacity. It is also obvious that the closer this side track can be maintained to the working territory the less time will be required for the gathering locomotive to change its trips.

In making this discussion it is rather difficult to deal with the sources of haulage delays in general terms and their effect on the productive capacity of an operation can be more clearly seen by citing some special example. However, it is not the purpose of this report to discuss the operation at any particular mine and the figures which are used in the following curves and graphs are more or less arbitrary assumptions to cover a range of operating conditions. For the curves in this report the trip is arbitrarily taken at 5 cars and the time of changing at 5 minutes and this operation is compared with one where the car supply is so maintained that the delays between trips are entirely eliminated. The time lost in moving from one room to another will also vary at different mines and in the absence of any definite figure this is assumed to be 10 minutes in the curves.

Figures 1, 2, and 3 show loading machine operations plotted to include a complete room cycle and showing the delays caused by single car changes, trip changes and moving from one room to another. In each of these illustrations the loading machine is assumed to have a capacity of 2 tons per minute. In each figure a different set of operating conditions is taken to show the relative or proportional effect of the transportation delays with different mine car capacities and


Curves plotting time schedules for one room cycle
TONS LOADED
TIME OF OPERATION
moving into room
1-min. for loading single cars
1-min. delay for changing single cars
5 min. delay for changing trips
10 MIN
20 MIN
30 MIN
40 MIN
50 MIN
60 MIN
70 MIN
80 MIN
90 MIN
D 10 min. MOVE 30 min. LOADING 30 min. CAR CHANGES 70 min. for one room cycle producing 60 tons
C 10 min. MOVE 15 min. LOADING 15 min. CAR CHANGES 40 min. for one room cycle producing 30 tons
95 min. for one room cycle producing 30 tons
B 10 min. MOVE 30 min. LOADING 30 min. CAR CHANGES 25 min. TRIPS
A 10 min. MOVE 15 min. LOADING 15 min. CAR CHANGES 10 min. TRIPS 50 min. for one room cycle producing 30 tons
Graphs showing amount of time for one room cycle
D 43% LOADING 43% CAR CHANGES 14% MOVE
C 33.5% LOADING 37.5% CAR CHANGES 25% MOVE
B 31.5% LOADING 31.5% CAR CHANGES 26% TRIPS 11% MOVE
A 30% LOADING 30% CAR CHANGES 20% TRIPS 20% MOVE
Time percentages of shifts used for loading, haulage and room moves

NOTE

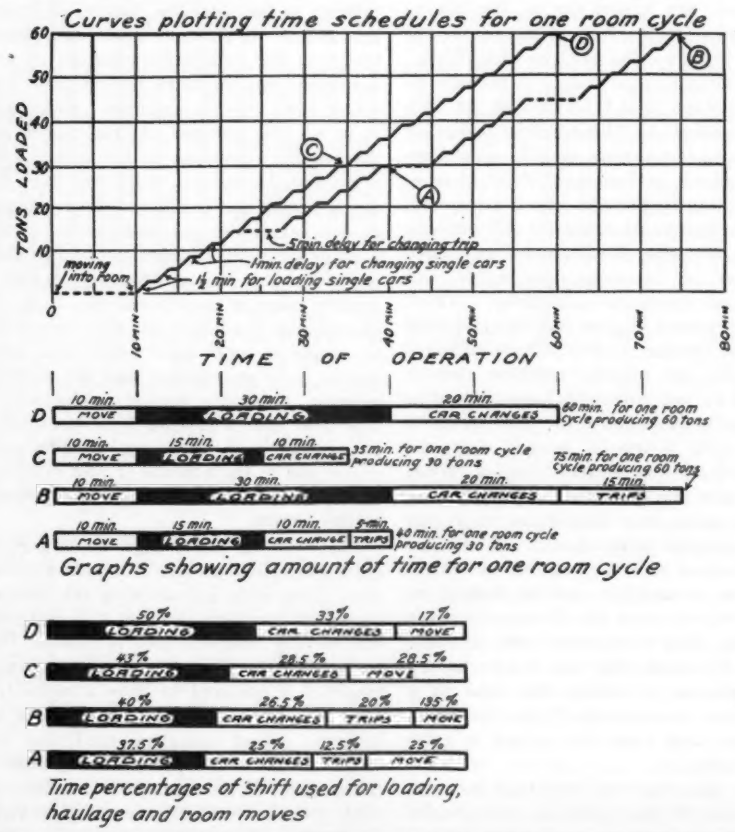
Curves A-B and C-D show the operating time and tonnage of a mechanical loader with a loading rate of 2 tons per minute loading into 2-ton mine cars with a time of one minute for the single car change.

Curve A-B shows the schedule where 5-car gathering trips are used with a delay of 5 minutes for changing trips. Point A shows the completion of a 30-ton room. Point B shows the completion of a 60-ton room.

Curve C-D shows the schedule where there is no delay between gathering trips. Point C shows the completion of a 30-ton room. Point D shows the completion of a 60-ton room.

Slanting lines indicate time and tonnage while machine is loading. Horizontal lines indicate non-productive time while machine is idle.

FIGURE 1


Curves plotting time schedules for one room cycle
TONS LOADED
TIME OF OPERATION
moving into room
½ min for loading single cars
1 min. delay for changing single cars
5 min. delay for changing trip
10 MIN
20 MIN
30 MIN
40 MIN
50 MIN
60 MIN
70 MIN
80 MIN
D 10 min. MOVE 30 min. LOADING 20 min. CAR CHANGES 60 min. for one room cycle producing 60 tons
C 10 min. MOVE 15 min. LOADING 10 min. CAR CHANGES 35 min. for one room cycle producing 30 tons
75 min. for one room cycle producing 60 tons
B 10 min. MOVE 30 min. LOADING 20 min. CAR CHANGES 15 min. TRIPS
A 10 min. MOVE 15 min. LOADING 10 min. CAR CHANGE 5 min. TRIPS 40 min. for one room cycle producing 30 tons
Graphs showing amount of time for one room cycle
D 50% LOADING 33% CAR CHANGES 17% MOVE
C 43% LOADING 28.5% CAR CHANGES 28.5% MOVE
B 40% LOADING 26.5% CAR CHANGES 20% TRIPS 13.5% MOVE
A 37.5% LOADING 25% CAR CHANGES 12.5% TRIPS 25% MOVE
Time percentages of shift used for loading, haulage and room moves

NOTE

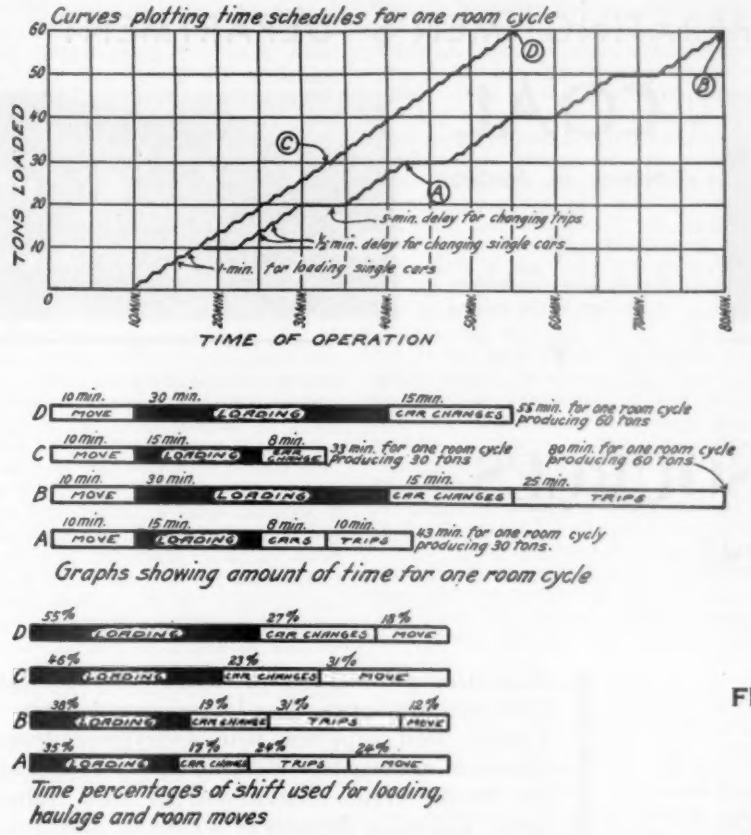
Curves A-B and C-D show the operating time and tonnage of a mechanical loader with a loading rate of 2 tons per minute loading into 3-ton mine cars with a time of one minute for the single car changes.

Curve A-B shows the schedule where 5-car gathering trips are used with a delay of 5 minutes for changing trips. Point A shows the completion of a 30-ton room. Point B shows the completion of a 60-ton room.

Curve C-D shows the schedule where there is no delay between the gathering trips. Point C shows the completion of a 30-ton room. Point D shows the completion of a 60-ton room.

Slanting lines indicate time and tonnage while machine is loading. Horizontal lines indicate non-productive time while machine is idle.

FIGURE 2


Curves plotting time schedules for one room cycle
TONS LOADED
TIME OF OPERATION
5-min. delay for changing trips
½ min. delay for changing single cars
1-min. for loading single cars
Graphs showing amount of time for one room cycle
Time percentages of shift used for loading, haulage and room moves

Curves A-B and C-D show the operating time and tonnage of mechanical loader with a loading rate of 2 tons per minute loading into 2-ton mine cars and with a time of one-half minute for the single car changes.

Curve A-B shows the schedule where 5-car gathering trips are used with a delay of 5 minutes for changing trips. Point A shows the completion of a 30-ton room. Point B shows the completion of a 60-ton room.

Curve C-D shows the schedule where there is no delay between gathering trips. Point C shows the completion of a 30-ton room. Point D shows the completion of a 60-ton room.

FIGURE 3

different times for single car changes. The four graphs immediately under the curves divide the total amount of time consumed in each room cycle to show what amount is used for loading, single car changes, trip changes, and moving to the next room. The second set of graphs show the time of these operations reduced to a percentage of the entire cycle and this same percentage would apply to the operation during an entire 8-hour shift. These latter percentage charts show a direct comparison of the time losses due to haulage in the four operating methods scheduled in the curves submitted with each figure.

The percentage curves with each of these figures show an interesting fact. An increased room width does not cause the production increase that would naturally be expected and in the operations where there is a marked delay caused by trip changes the effect of increasing the width of the rooms is practically negligible. For example, in *Figure 1* the increase of from 30 to 60 ft. in the room width reduces the number of rooms loaded during an 8-hour shift from 10 to 5. This eliminates 5 moves and adds 50 minutes to the operating time but this operating time is reduced by the trip delays and the car change delay so that the actual increase of the productive time during the shift is from 30 to 31.5 percent. In this particular example an increase of 1.5 percent in the loading time amounts to 1.5 percent of 8 hours, which is approximately 7 minutes. With a loading machine rate of 2 tons per minute this would mean an increased production of only 14 tons in each 8 hours. Where there is no delay due to trip changes the wider room increases the productive loading time from 37.5 to 43 percent, which amounts to 48 tons. These proportions vary in *Figures 2 and 3* but they all illustrate the same point, which is that the gathering haulage delays have a more important effect on the productive capacities than the room moves and that the haulage operation should be brought to its highest efficiency before attempting to increase the room widths.

The importance of analyzing the transportation methods and determining the amount of delay caused by each phase of the haulage is evidenced by the percentage figures in the curves. These show that the haulage losses under certain conditions may amount to as much as 70 percent of the total operating time. While this figure is exceptional, such operations do undoubtedly exist, although the average haulage loss in a well operated and well scheduled mechanical mine may not be more than 40 percent of the total time. However, it is possible to reduce these losses. The value of such reductions can be very closely estimated in dollars and cents. For instance, if the cost of operating a mechanical loading unit is assumed at $100 per day, then 40 percent of the time lost would mean that the haulage delays were costing the mine $40 a day. In such case an analysis would show where these losses occur and it could be fairly accurately determined how much expense for new equipment or additional labor would be justified to reduce this figure.

These three illustrations do not include a wide range of conditions but three are submitted in order to show the relation between the productive capacity and each of these transportation factors. This relation is not at all simple and a change in any of these factors changes the proportion or percentage of all of the remainder. This is clearly seen by comparing the effect of eliminating the trip delays in the percentage charts of *Figures 1, 2, and 3*. This emphasizes the importance and necessity for time studies and intelligent analyses of these studies to determine how the efficiency and the production of any particular operation can be increased.

COAL

NEWELL G. ALFORD
Editor

Practical Operating Problems of the Coal Mining Industry

The COAL RESOURCES of the Northwest

By GEORGE WATKIN EVANS *

Marketing possibilities discussed—Crows Nest Pass area the outstanding bituminous deposit—Canada well supplied with everything from lignite to anthracite—Washington reserves lead the Pacific states—Idaho coal of local value only—Extensive deposits in Wyoming, Montana, Utah and Colorado discussed—Oil a competitor with Oregon and California coal.

I HAVE been requested to present a paper outlining the coal resources of the Northwest. The term "Northwest" is rather indefinite, so an interpretation of its meaning will be in order at this time. In some parts of the United States the area including Michigan, Minnesota, and the Dakotas is frequently referred to as the Northwest, but in more recent years the Pacific Northwest has become the real Northwest. I believe a discussion of the coals in the Northwestern States would be incomplete without adding thereto a discussion of the coals of a portion, at least, of Alberta and British Columbia in Canadian territory. By adding portions of these two provinces the picture will then be complete. I will discuss very briefly the coal situation in California and in Oregon, not so much to bring out the values of these coal areas, rather to bring out the fact that neither one of these states contain large areas of valuable coal, and this fact has direct bearing on the marketing possibilities of near-by states that do contain coal of good quality.

A mere discussion of coal areas will not have a great deal of value unless we take into account the market for these coals, and when the question of market is considered then we must recognize the very important part that California oil plays. No effort will be made to discuss the markets in any detail, but the aim will be to give a bird's-eye view of the coal resources and the bearing they have on the commercial life of the western United States and Canada.

In preparing this paper I have used material from the United States and Canadian Geological Survey Reports, and in preparing the map have used the maps of the United States Geological Survey and the Canadian Geological Survey. I have personally examined nearly every coal field discussed in this paper, so that it really becomes a compilation of personal examinations and material from the two Government surveys listed above.

BRITISH COLUMBIA

In my discussion I will begin in Canada and work in a southerly and southeasterly direction in my descriptions of the coal areas. In British Columbia there is a large number of coal deposits, most of which belong to the Cretaceous age. I will not attempt to describe in detail all of the coal within this province, but will enumerate first of all the prominent areas. Near the headwaters of the Skeena River is an area of coal measures frequently referred to as the "Groundhog District," in which there is coal of an anthracitic nature. There is a large area of coal bearing formation which, before the World War, was heralded as the greatest anthracite coal field in the world. I examined the field in 1912 and found an extensive coal area, but concluded that the character of the coal, the cost of mining, the remoteness of the area from present transportation, formed a combination that made it impracticable to consider this coal area as an asset of the present date. It will have to be regarded as a reserve of the future. There are other areas in this same general district not far from the town of Hazelton, B. C., where attempts are being made at present to develop commercial coal mines. On Queen Charlotte Island there is an area of coal-bearing strata which contains some coal of good quality, but severe faulting and folding and intrusions have rendered this field questionable in so far as profitable coal mines are concerned.

* Consulting coal mining engineer, Seattle, Wash.

Presented to the Annual Meeting of the Western Division of the American Mining Congress, Spokane, Wash., Oct. 2, 1929.

The important coal areas of western British Columbia are located on Vancouver Island along the east shore. There is an area of coal that an Indian village called "Suquash," near the southern end of Queen Charlotte Sound, that has not been prospected very thoroughly, but, as far as can be seen, gives promise of having commercial value, due to the fact that the formation is fairly regular and the coal beds are located on tidewater. Farther south and about midway along the east shore of Vancouver Island is a large area of bituminous coal of good quality in which the mines of the Canadian Collieries are operating in what is known as the "Cumberland District." There are a number of coal beds in this series, the coal is of good quality, principally for steam-making purposes. A large part of the business of this area is to supply steamers with bunker coal. From all indications, there still remains within this district a large tonnage of excellent coal, so that we can expect this area to be an important factor for many years in supplying coal for the markets tributary to it.

Farther south, and about 75 miles north of Victoria, is a smaller area of very good bituminous coal near the distributing port of Nanaimo. The greater part of this area is owned jointly by the Canadian Collieries and the Western Fuel Company. This coal is suitable for steam purposes and there is also some coking coal, and it also produces an excellent quality of domestic coal. The recoverable tonnage within this field is considerable, but not as great as one would be led to believe from reading Government reports on the district. Coal has been mined within this area for 70 or 80 years and the district will continue to be, for many years to come, an important factor in the commercial life of southwestern British Columbia. Some of this coal finds its way into domestic markets of Puget Sound.

To the north of the city of Vancouver some distance, and not a great distance from the head of Howe Sound, is an area of limited extent, containing coal of lignitic character. It is reported that some of these bodies of coal are very thick, due to folding. The field has not been developed a great deal, but when powdered coal becomes more general than at present and when low-temperature distillation is more practical than now, this field, no doubt, will be developed and will become an important one. There are other areas of lignitic coal that have been developed more or less, at the towns of Merritt and Princeton. There is also a small area of bituminous coal at Coalmont.

The outstanding deposit of bituminous coal of high grade in British Columbia is in the southeastern corner of the province in the Crows Nest Pass District. There are several large areas of high-grade bituminous coal close to the boundary line between Alberta and British Columbia that extend in a northwesterly direction paralleling the axis of the Canadian Rocky Mountains, which extend from a point not far north of the Montana boundary line for several hundred miles, first of all through portions of British Columbia, then apparently cut through the Canadian Rockies from the western slope to the eastern slope and continue northwesterly paralleling the main range of the Rockies, but on the eastern slope instead of the western slope. These beds, for the greater part, contain bituminous coal, most of which will coke, but in places on the eastern slope of the Canadian Rockies, in the area east and southeast of Banff, on the Alberta side, they have metamorphosed into anthracites and anthracitic coals.

Returning, now, to a further discussion of the coals within the British Columbia proper, the Crows Nest Pass Coal Company, a subsidiary of the Great Northern Railroad, owns a very large acreage containing a tremendous total tonnage of high-grade coal in the Crows Nest Pass area, extending from the town of Morrissey northerly along the flank of the Canadian Rockies to points north of the town of Michel. The Great Northern Railway extends up from Montana into this district as far as Fernie. The Canadian Pacific Railway crosses through this coal field and serves it east and west.

The most unusual deposit of coal in British Columbia, if not in all of North America, is at Corbin, British Columbia, and consists of a series of coal bodies in the form of synclines. The Corbin area is a portion of the Crows Nest Pass coal field, but, due to the peculiar concentration of coal beds in the form of synclines, some of these deposits are from four to five hundred feet across from wall to wall and, where some tests have been made, there is only 20 percent waste material within cross sections approximately 252 ft. thick. The coal at Corbin is a little lower in volatile than the true coking coals of this district and produces a very popular domestic fuel when used as a furnace coal.

The coals of Fernie, Michel, and Corbin are tributary to the same general markets and furnish coals for the Canadian Pacific Railroad for its use, and some of the coal is shipped as far east as Winnipeg, as far south as Spokane, and into points in Montana, also into the Kootenay district of British Columbia. A small amount of the coal finds its way into Calgary. Needless to say, there is sufficient tonnage in this field to last for an indefinite period of time.

George Watkin Evans

Alberta

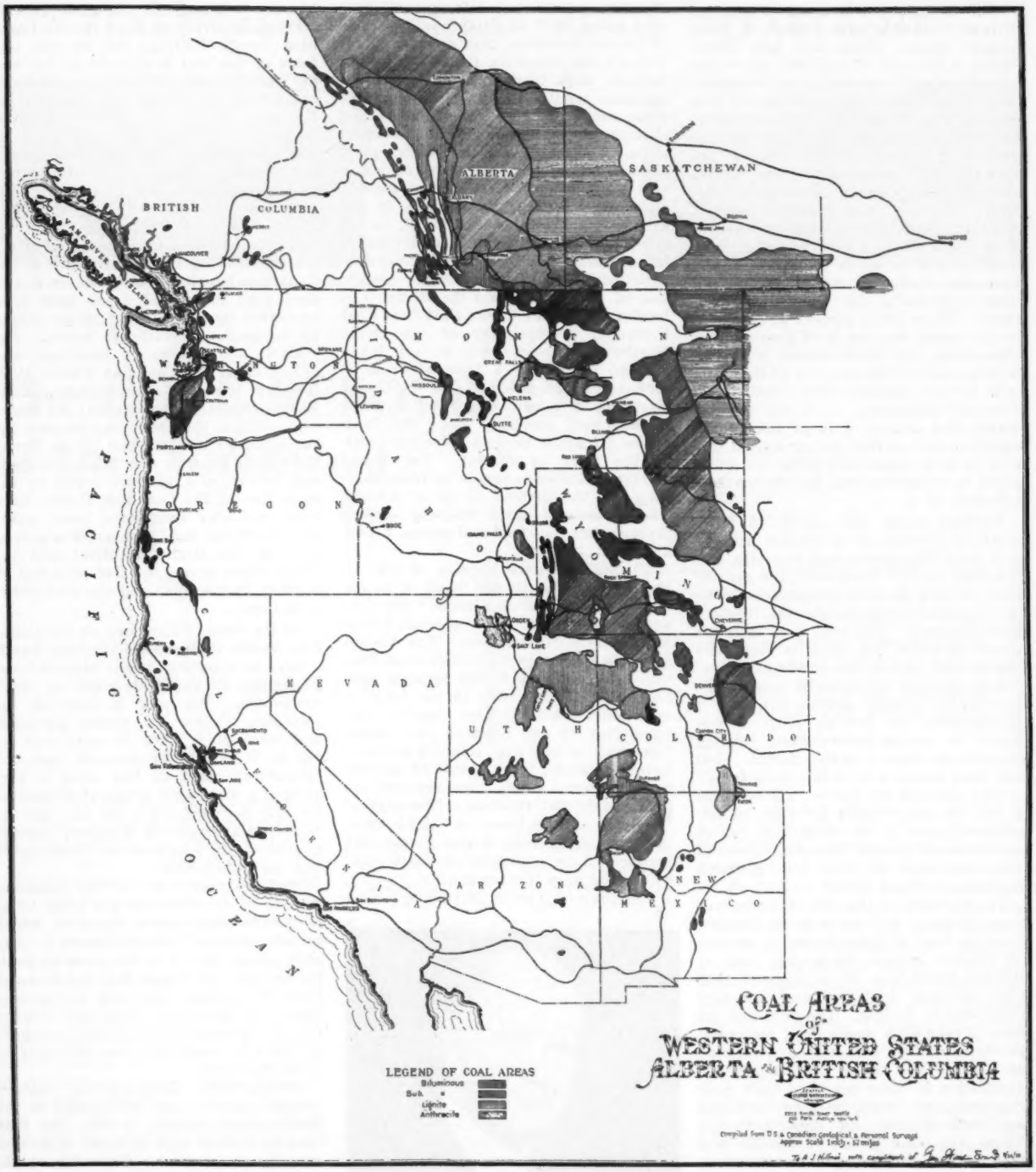
Returning again to a discussion of the coal areas along the eastern slope of the Canadian Rockies in Alberta, it is evident that these coal areas have been separated into paralleling strips caused by tremendous overthrust faults. The coals in the vicinity of Blairmore and Coleman, on the Canadian Pacific Railroad, are bituminous and slightly coking. They produce a good quality of steam coal. Within the area lying between the Canadian Pacific Railroad in the Crows Nest Pass District and Banff, which is well known as a summer resort on the main line of the Canadian Pacific Railroad, the coal beds have been rather severely folded and in a number of places, such as the Highwood River and the Sheep River areas, the coal beds are 30 to 50 ft. in thickness and are anthracitic in nature.

At the town of Canmore, on the Canadian Pacific Railroad not far from Banff, a mine is operating at the present time, producing an excellent grade of semi-anthracite. The coal is used on the Canadian Pacific for steam purposes, and some of it finds its way east as far as Winnipeg for domestic uses. A briquetting plant at this mine is furnishing a very good grade of briquettes for the domestic trade as far east as Winnipeg and into the Kootenay country and points in northeastern Washington and northern Idaho.

Within the area east of the Canadian Rockies in Alberta there are large areas of coal-bearing strata, most of which contain coals of subbituminous or lignitic character. For the greater part, the beds are practically flat, and in many cases of younger age than Cretaceous. These coal areas are important mostly, from a Canadian point of view, to supply the domestic needs of areas tributary to those coal fields.

Summarizing, therefore, for western Canada and its coal relationship to the Northwestern States, I will say that Canada is very well supplied with coal ranging in character from lignite to semianthracite. These two provinces, Alberta and British Columbia, will continue for many generations to be important coal-producing districts. They can supply their own needs and, where freight rates are at all favorable, they can ship into American markets. When the production of oil in California is curtailed considerably below the present point, the coal areas of southern Alberta and southeastern and southwestern British Columbia will be greatly benefited and the coal development should be very healthy and profitable.

V 15 11 1 NOV 19



WASHINGTON

The State of Washington contains by far the most important coal areas of any of the states bordering the Pacific Ocean. The tonnage of coal within this state is far in excess of any of the other Pacific Coast States and in quality there is a much greater variation. This state contains coal ranging from lignites at points near the Columbia River to anthracites at three points within the state, namely, Cowlitz Pass, Carbonado, and Glacier.

The most important coal-producing counties are King, Pierce, Thurston, and Lewis Counties, in the western part of the state, and Kittitas County, east of the Cascade Mountains. There is also an important coal-producing area in Whatcom County, near Bellingham, but the area is not as extensive as the areas within the other counties.

In King County, not far from Seattle, there are large areas of coal-bearing strata that contain a total tonnage sufficient to last for several generations. They range in character from subbituminous within 2 miles of the city of Seattle to coking bituminous at the Pocahontas mine, which is located along the western foot of the Cascade Mountains. In Pierce County, of which county Tacoma is the county seat, there are large areas of coal ranging in character from noncoking bituminous to coking bituminous throughout the greater part of the eastern portion of the county. At one

place, namely, Carbonado, there has been mined a small area of anthracite coal.

In Thurston and Lewis Counties, of which Centralia is the principal distributing point, there is a very large area of subbituminous and a small area of bituminous coal. The total tonnage of coal within this district is very large and will continue to produce coal for hundreds of years at the present rate of production, and when powdered coal and low-temperature distillation become more generally used than at present, this field will prove to be a very important one. It lies about midway between the city of Portland, in Oregon, and the city of Seattle, in Washington, approximately 100 miles from each city.

In eastern Washington, in the so-called Cle Elum-Roslyn Field, the coals range in character from subbituminous at the eastern end of the field to bituminous at the western end. The area of coal within this district is quite limited and the recoverable tonnage is also limited. The Northwestern Improvement Company, a subsidiary of the Northern Pacific Railroad, is a principal owner and producer of coal in the Roslyn field. This field supplies the Spokane market to a large extent.

Prior to the enormous production of California oil, the coal mines in the vicinity of Seattle and Tacoma shipped coal into the California markets. With the tremendous output of California oil the tables have been turned, and now California fuel oil has displaced a very large tonnage of coal formerly produced in the Washington mines. With the California oil production limited, the coal areas in western Washington in particular will receive a very strong impetus, and will become much more important factors in the commercial life of Washington than at present. This field contains a large tonnage of coking coal suitable for making coke for blast furnaces, and this in itself is of great importance.

It has been found that modern steam plants using steam turbines can successfully compete with hydro-electric plants. The far-seeing and progressive Puget Sound Power & Light Company, a subsidiary of the Stone Webster Corporation, is building a large steam plant on the shores of Lake Washington which will probably use oil while it is selling at a low cost, but later, when oil is more expensive, no doubt they will use powdered coal furnished by the several coal mines within easy reach of the plant.

When powdered coal is more generally used on vessels than at present, the coal mines of western Washington can produce an unlimited amount of fuel for an almost indefinite period of time. There is no reason why the vessels plying to the Orient and to Australia should not be using powdered coal produced from the mines of this state.

Idaho

In the State of Idaho there is a very small area of coal near the town of Driggs, not far from the Wyoming line.

PRODUCTIONS OF COAL IN BRITISH COLUMBIA, ALBERTA, WASHINGTON, MONTANA, WYOMING, UTAH, COLORADO, NEW MEXICO FOR 1923-26-27

	1923	1926	1927
British Columbia	2,453,223	2,330,036	2,453,827
Alberta	6,854,397	6,503,705	.....
Washington	2,926,392	2,586,568	2,635,062
Montana	3,147,678	2,797,760	3,143,638
Wyoming	7,575,031	6,512,288	6,753,656
Utah	4,720,217	4,373,793	4,781,480
Colorado	10,346,218	10,637,225	9,724,075
New Mexico	2,915,173	2,817,923	2,935,539

This limited deposit of coal appears to be a northwesterly extension of the coal areas in western Wyoming. The area is badly faulted, the coal beds dip at high angles, and the percentage of lump coal is limited. The coal areas of Utah and Wyoming, where coal can be mined very cheaply, will always dominate the coal markets within several hundred miles of these operations. Such areas as the Teton coal field of Idaho, although important for local demands, will always find it difficult to expand their markets in competition with areas where coal of good quality can be mined at low cost. The Driggs coal field is important only for local use.

Montana

Montana has a number of coal areas extending from the northwest portion of the state to the southeast corner, in disconnected areas. In the Glacier Park District there is a limited area of subbituminous coal, but little or no attention is being paid to it at this time. East of the foothills of the Rocky Mountains there are two areas of bituminous coal, one in the vicinity of Great Falls and the other to the northwest of that area. The Great Falls area extends from a point west of the city of Great Falls to a point east of Lewiston. North of the Great Falls area and between that district and the Canadian boundary is an area containing several small subdivisions of subbituminous coal. To the southeast of the Great Falls District is an area of subbituminous coal known as the Bull Mountain Field. A subsidiary of the Chicago, Milwaukee & St. Paul Railroad owns and operates mines in this field. Southwest of the Bull Mountain Field is a rather extensive coal area known as the Big Horn Basin. Along the northern limits in the district of which Red Lodge is the center the coal is bituminous in character, but to the south and southeast it becomes more subbituminous in nature. Several important mines are operating in the Red Lodge Field. The Northwestern Improvement Company, a subsidiary of the Northern Pacific Railroad, owns and operates important mines within that district. There is a small area in the vicinity of Livingston, Mont., containing bituminous coal, but little or nothing is being done in this district at the present time.

The eastern one-third of the State of Montana is almost entirely underlaid with coal. The western portion of this coal area from Piny Buttes to the Wyoming boundary, as far west as Big Horn and as far east as Miles City, is underlain with subbituminous coal. From Miles City eastward to the eastern boundary of Montana and for a considerable distance into North Dakota and partly into South Dakota is a large area of lignitic coal. This same lignite area extends northwesterly into Saskatchewan.

The total tonnage of coal in the State of Montana is very great, but most of this is made up of subbituminous and lignitic coals. There is only a limited amount of commercially valuable bituminous coal, and very little of this is suitable for making coke. In fact, nearly all of the coke used in the State of Montana is shipped in from Colorado, Utah, and British Columbia.

In the area south of Forsythe, in what is known as the Rose Bud District, the Northwestern Improvement Company is operating a large and commercially successful strip mine. The overburden, consisting very largely of poorly consolidated sandstone, is stripped by steam-shovel operations, thereby exposing a bed of clean, subbituminous coal ranging from 28 to 32 ft. in thickness. The Northern Pacific Railroad has proved that it can use this grade of coal to its advantage in locomotives. In order to obtain best results they have made material changes in the types of grates used.

With the general introduction of powdered coal and low-temperature distillation, the subbituminous and lignitic areas of Montana should prove to be valuable assets to that state. There is sufficient coal in Montana to last both that state and the surrounding country for an indefinite period, and the mining conditions are such that it can be cheaply mined.

Wyoming

The State of Wyoming contains several areas of coal-bearing strata. There are three or more types of coal in this state. Along the western margin of the state and paralleling the western line are several narrow areas containing bituminous coal. In some places these beds dip at rather high angles. Some of the coal has been coked, but the coke produced is not as satisfactory as that produced in other places.

In the southwestern portion of the state there is a large area radiating in all directions from the important coal-mining center of Rock Springs. The beds in the lower zones of the formation contain bituminous coal, and farther up in the series they become less bituminous, and at the top the beds are subbitumi-

nous. The Union Pacific Railroad, through its subsidiary, the Union Pacific Coal Company, owns and operates a number of coal mines in the Rock Springs District. In addition to the operations of this company, several commercial companies operate mines and distribute coal into the Northwest and also East from this field. None of the coal within this area has been coked on a commercial scale.

The Union Pacific Coal Company is a very progressive organization, and its officials have successfully introduced mechanical loading in its mine. This is the district in which the well-known Duck Bill was originated and is being used to produce coal at a much reduced cost below that of hand loading. They have proven that by using mechanical loading they can operate coal beds successfully that were not profitable by ordinary hand loading, due to the very friable character of the roofs.

Along the eastern margin of the so-called Green River Region, of which Rock Springs is the chief mining center, is an area containing coal bordering on subbituminous or what might be termed a low-grade bituminous, and to the east of this zone of coal-bearing area is the Hanna Field. This area contains both low-grade bituminous and subbituminous coal. The Union Pacific Coal Company operates some of the most important coal mines in this district, and has successfully used power shovels underground in beds over 30 ft. in thickness. Southeast of the Hanna Field is a small area known as the Rock Creek Field, but the amount of coal mined in this district is negligible.

In the northern portion of the state the Big Horn Basin region extends south from Montana and represents a very large tonnage of subbituminous coal, some of which is of good quality. The Burlington Railroad passes through this district. East of the Big Horn Mountain is a very large area of subbituminous coal known as the Powder River region. This area extends from Montana southward into Wyoming as far as Casper, on the Burlington Railroad.

In the extreme northeastern portion of the state, along the western flanks of the Black Hills, is an area containing bituminous coal. The coal deposits are limited in extent and the operations within this field are not very extensive.

The State of Wyoming contains an exceedingly large total tonnage of coal. The amount of high-grade bituminous coal is somewhat limited, but the total tonnage of subbituminous coal is practically inexhaustible. This state will for many years continue to supply certain markets west and east of the state itself, as well as the needs of the industrial life of Wyoming.

Utah

Utah contains a very large total tonnage of high-grade bituminous coal. The Uinta Coal Field extends from points not far east of the city of Provo eastward to the Colorado boundary, and extends for some distance into the latter state. The most important portions of this field, in so far as the State of Utah is concerned, are the areas in Carbon County and Emery County.

Price, Utah, is the central distributing point for the Carbon County Field and such well-known mining districts as Spring Canyon, Castlegate, Sunnyside, and Columbia are within this area. There are coal beds within this part of Utah that range in thickness from 3 ft. to nearly 30 ft. The coal, as a rule, is a strong black bituminous coal that produces a large percentage of lump coal. The beds dip at gentle angles and, for the greater part, the areas are not badly disturbed by faulting. This happy combination makes it possible to produce a good grade of coal in this field at a reasonable cost. The coal stands weathering very well and is popular with the coal dealers for this reason.

Mechanical loading is used in the Carbon County coal field and is gaining favor. Coal beds from 20 to 24 ft. in thickness are being successfully mined by the use of undercutting machines and mechanical loaders.

The Carbon County coal district ships coal into the Northwest and Southwest for domestic use. A considerable tonnage of this coal is used in the city of Seattle, also in Tacoma, Spokane, Portland, Oreg., San Francisco and Los Angeles, Calif. The railroads also use this coal in places where oil is not used.

In the southwestern portion of the state is an area known as the southwestern Utah region and contains a considerable area of coal-bearing strata in which the coal is a cross between bituminous and subbituminous. There is no railroad serving this area at this time, and only enough coal for local use is being mined. This district is much closer to Los Angeles than the Carbon County field and at some future time, when powdered coal replaces California oil for steam-generating purposes, it might prove to be a satisfactory supply of coal to take care of the needs of the area tributary to Los Angeles.

There is a small area of subbituminous coal a short distance east of Salt Lake City, but the amount of work being done in this field is somewhat limited.

The coal resources of Utah are of such magnitude and of such good quality that this state can be properly considered as one of the most, if not the most, important high-grade coal-producing state in the West. I believe the character of the coal and the low cost with which it can be mined make this state a more important one even than Colorado, in so far as coal resources are concerned. A considerable amount of the coal at Sunnyside and at Columbia have been successfully coked. The coke produced has been found to be satisfactory for iron and steel making.

The Denver & Rio Grande Railway and the Utah Coal Route traverse these coal fields and supply transportation for distributing the coal to the north, the northwest, and other points.

Colorado

The State of Colorado can hardly be considered tributary to the Northwest, but inasmuch that some of the coke produced in that state is shipped as far north as Montana it might be well to consider the coal resources very briefly.

There are a number of coal areas in Colorado in the northerly portion of the state, and in the northwest area the coal fields extend southeasterly from Wyoming into what is known as the Yampa Field. The coal beds in this district are anthracitic, bituminous, and subbituminous. In the northwestern portion of Colorado the Uinta coal region extends west from Utah, and represents a tonnage of coal ranging in character from anthracite to low-grade bituminous. The anthracitic nature is caused by intrusive rocks in the form of sills which have changed the coals locally from bituminous to anthracite.

In the area to the north, east, and south of Denver for a considerable distance is a coal-bearing district known as "The Denver Region." Within this area is a large total tonnage of subbituminous coal. A considerable amount of this coal is mined for general domestic use. There is also an area to the northwest of the Denver Region known as the "North Park Region" which contains subbituminous coal, and to the southwest of Denver is a small area of low-grade bituminous coal known as the "South Park Area."

West of Pueblo, along the line of the Denver & Rio Grande Railroad, is a small area containing a low-grade bituminous coal near Canyon City.

In the southwestern portion of the state is an era known as the "San Juan River Region" that contains a high-grade bituminous coal in the vicinity of Durango. These coal beds change in character from a high-grade bituminous coal to a subbituminous coal to the southeastward, and extend into the northwestern part of New Mexico. Some of the coal in the vicinity of Durango makes a very good grade of coke. The beds are thin, and as a result the costs of mining are relatively high. The district is served only by a narrow-gauge railroad, and it is so far removed from industrial centers that the field is not likely to be a very important producer for many years.

In south-central part of Colorado is an area known as the "Raton Mesa." The northern part of the field is known as the "Trinidad District" and the southern part known as the "Raton District." This field contains a considerable area of bituminous coal and such important coal-producing centers as Walsenburg and Trinidad are located in this field.

A considerable amount of coke has been made in the past within this area, and at present some coke is being produced, but the development of oil and gas in Oklahoma and Texas has proven too much of a handicap for marketing this coal. A great number of the coke ovens that were formerly used are now idle.

Colorado, because of its very large coal reserve and the varying qualities of the coal, will always be a very important coal-producing state, and when

the time arrives that Oklahoma and Texas oils are produced at a greater cost than at present, then these coal fields will become very important factors in the industrial life of Colorado.

Oregon

I have discussed the most important coal-bearing states tributary to the northwest and will now discuss the two least important states, in so far as their coal reserves are concerned, namely Oregon and California. More coal is shipped into the state of Oregon than is mined within the state, and there is little or no coal mined in the state of California.

There are several coal areas in Oregon, but the most important one is the Coos Bay Coal Field. This district supplied coal for the San Francisco market 25 or 30 years ago, but since the influx of fuel oil, California oil is now used very largely in the Coos Bay District. The coal in that area is subbituminous, of fair quality. It is a bright shiny coal, but will not stand weathering very well. South of the Coos Bay District is a small area of low-grade bituminous coal at Eden Ridge and in the southern limits of the state, close to the line of the Southern Pacific Railroad in the Siskiyou Mountains is a narrow strip of coal-bearing strata that contains lignitic coals.

The only chance the Oregon coal fields have will be when the production of California oil will be limited and that the price of fuel oil in the Oregon markets will be much greater than at present.

California

The coal areas of California are limited to a small area that extends southward from Oregon into the Siskiyou Mountains containing a low-grade bituminous coal, several small areas of lignite coal, southeast of Eureka, a small area of bituminous coal at Dos Rios, an area of subbituminous coal at Mt. Diablo, an area of lignitic coals east of Redding, some lignitic coals east of Sacramento, a bituminous coal at Stone Canyon and small, disconnected areas of subbituminous and lignitic coals scattered over various parts of the state.

The best grades of coal in the state are at Dos Rios, Stone Canyon and Mt. Diablo. Coal was formerly mined at Mt. Diablo and a limited amount has been mined at Stone Canyon and some prospecting has been done at Dos Rios.

The production of California oil has discouraged any future coal development in the state of California, and this condition will probably continue until the price of fuel oil becomes much greater than at present and when that time arrives the areas that will receive attention will be the Stone Canyon area, the Mt. Diablo area, the coal beds at Dos Rios and a rather extensive deposit of lignitic coal northeast of Redding.

The states of Utah and Wyoming ship in the greater portion of the coal used in the state of California. There is a limited amount shipped in from New Mexico. California, no doubt, will continue to ship coal from Utah for many years, even after its own coal areas are more fully developed and are operating.

Summary

It will be seen from the foregoing discussion that the Pacific Northwest need not fear a fuel famine for many generations. The state of Washington can supply its own needs for many, many years, except some lump coal that is shipped in from other areas. Western Oregon can supply its own needs if the people would be willing to use the coal, but this state, no doubt, will continue to ship coal from Wyoming and Utah, also some from the state of Washington. The state of Idaho will have to depend upon Montana, Wyoming and Utah for its coal supply. Nevada will also have to look to Wyoming and Utah for its coal needs. California as stated, will look to Utah, and Wyoming, for its supply of coal, but Montana, Wyoming, Utah and Colorado can supply their own needs for an indefinite period.

In Canada, the Province of British Columbia can supply its own needs and the needs of southeastern Alaska for several generations. Alberta has probably the greatest coal reserve of all types of coal of any state or province in North America. Its crying need is an outlet for its coal supply.

It is probably superfluous to add any figures that would represent tonnage estimates. However, I will give some figures that are supposed to represent the total tonnage of coal contained within the areas I have discussed. These figures are taken from United States and Canadian Geological Survey bulletins. Within the area known as the Northern Great Plains Province including the Fort Union Region, small fields in Montana, Denver and Canyon City and Raton Mesa the figures given are as follows 1,294,525,400,000. For the Rocky Mountain Province including small fields in Montana, Big Horn and Wind River Basins including Red Lodge Field, Green Rivers and Hams Fork Region and Hanna Field, Uinta Region and Wasatch Plateau, North and South Parks, southwestern Utah, Coalville Utah, San Juan Basin, small fields in New Mexico and Arizona, Idaho and Nevada represent 1,068,425,700,000. Washington is suppose to have 63,845,900,000. Oregon and California are represented as having 1,043,000,000.

A glance at the above figures will show anyone that we need not worry about the coal resources tributary to the northwest.

According to the Canadian Geological Survey the total number of tons in British Columbia including coal beds over a foot in thickness and to a depth of 4,000 feet is 50,043,700,000. For Alberta it is claimed that the Kootenay formation which represents the coal bearing strata along the eastern slopes of the Canadian Rockies represent over 31,000,000,000. The belly formation of Alberta is supposed to contain 189,450,000,000. This same source of information states that the probable total reserves of Alberta for coal seams one foot or over in thickness to a depth of 4,000 feet represents 673,554,600,000.

Anybody interested can ascertain the yearly productions within the two Canadian Provinces and divide these productions into the total tonnage represented, then figure out for himself the length of time these coal resources will last. If he still has a little time to spare he can do the same thing for the States of Washington, Montana, Wyoming, Utah, and Colorado. I believe when he is through he will agree with the statement that the Northwest is well supplied with coal resources and we need not fear a fuel famine or a shortage of coal to supply the industrial needs of a population far in excess of the present.

USE OF FROTH-FLOTATION PROCESS IN CLEANING COAL

The froth-flotation process, used extensively in the concentration of ores, has been applied within recent years to the separation of coal from ash-forming materials, says the Bureau of Mines in Bulletin 300, dealing with coal washing investigations, recently issued. Briefly, the process involves the agitation of raw coal, 1/10-in. size or finer, with 4 to 10 times its weight of water and a small quantity of reagent (0.5 to 5 pounds per ton of dry coal). The reagent with air forms a froth supporting the coal, which floats at the surface and may be removed, while the ash-forming materials are largely rejected and remain in the bulk of the water and may be separately removed. Many reagents may be used; these include certain oils, soluble organic substances, certain alcohols, and soaps.

COMPARATIVE STUDY OF COAL CLEANING PROCESSES

The rapid increase in the efficiency of burning coal, by power stations and other fuel consumers, has brought about an increased demand for cleaner coal. This demand has been met by the producers by the installation of washing plants. There has been a marked increase in the number of mines that have installed wet or dry coal cleaning plants within the past few years.

The performance of plants using wet methods is fairly well known, but that of dry cleaning plants is not so well established because this method of treatment is comparatively new. No data giving a comparison of wet and dry methods on the same coal are available. In view of the importance of this subject and the need for comparative data, the Northwest Experiment Station of the Bureau of Mines, Seattle, Wash., has undertaken an investigation of the subject, in cooperation with the University of Washington. To this end a modern dry table plant was installed in a laboratory already elaborately equipped with wet cleaning apparatus.

V 15 11 NOV 29 XU

A group of delegates photographed in front of the Davenport Hotel.

WESTERN MINING CONVENTION

SPOKANE gathering brings together great group of mining men—Public land policy, blue sky regulation, and mine depletion keynotes of discussion — Trip through Coeur d'Alene district

Brent N. Rickard elected Chairman of the Board of Governors of the Western Division of the American Mining Congress. Mr. Rickard is manager of the El Paso Smelting Works of the American Smelting and Refining Company and is located at El Paso, Tex.

IN AN atmosphere reminiscent of the old days of western pioneer mining and in a spirit of confidence in the future development and growth of the mineral resources of the vast territory west of the Rockies, representatives of the mining fraternity held at Spokane during the first week in October one of the most important and interesting conventions ever conducted by the American Mining Congress. The occasion was the annual meeting of the Western Division of the American Mining Congress, with which were held meetings of the Northwest Mining Association, American Institute of Mining and Metallurgical Engineers, Canadian Institute of Mining and Metallurgy, and the Mining Bureau of the Spokane Chamber of Commerce. The convention sessions were held at the Spokane and Davenport Hotels from September 30 to October 3, and on October 4 and 5 the delegates enjoyed an excursion through the Coeur d'Alene mining district of Idaho. The convention was also featured by a very interesting ore exhibit comprising samples from both the United States and Canada and at its conclusion the exhibit, said to be worth $25,000, was donated by the Northwest Mining Association for permanent exhibition in Spokane.

The Western Division enlarged its territory by taking into its membership Alaska and that part of Texas west of the Pecos River and selected El Paso as the seat of the 1930 convention with Brent N. Rickard, manager of the El Paso Smelting Works, as chairman of the Western Division for the new year. Resolutions were adopted endorsing the plan of President Hoover to appoint a commission to study the public lands situation, with the recommendation that the commission include representatives of the mining industry and that the subsurface rights be not separated from the land. Computation of mine depletion allowances on the basis of net income was

favored and opposition to Federal regulation of securities was expressed. The American Mining Congress was authorized to study the question of compacts or agreements between the states looking to the control, conservation and development of natural resources, subject to approval by Congress.

Delegates returning from Spokane declared that the conventions were the largest, most enthusiastic, and constructive of that kind ever held. The interest in the mining discussions and the ore exhibit was keen and the attendance at all of the sessions was excellent. The arrangements for the sessions and the accommodations and facilities provided for the delegates under the supervision of Frank M. Smith, chairman, and Leon Starmont, secretary, of the Western Division, and L. K. Armstrong, of the Columbia section of the Institute, were planned with precision and all of the proceedings were conducted smoothly and on schedule. The influence and prestige of the American Mining Congress formed the nucleus, and the collaboration of the other mining organizations effected a setting which centered the attention of the entire West on the convention. Members of all the participating organizations arrived early and remained throughout the sessions, many of them also taking the two-day trip through the Idaho mines for which elaborate preparations were made. The banquet the evening of October 2 over which Stoddard King presided as toastmaster, was delightful in entertainment, wit, and social fellowship. A large number of ladies accompanied the delegates in attendance at the sessions, for whom many social affairs were provided by the ladies of Spokane. The delegates declared that the Inland Empire should be proud of its ability to entertain so large and important a gathering.

Mineral Exhibit

The mineral display was a striking feature at the convention, consisting of 454 exhibitors with over 10,000 exhibits and comprising a wealth of samples of metallics and non-metallics. With the exception of the exhibit from British Columbia no specimen in the collection had ever been on display before, each having been mined in July, August or September of this year. A striking feature was a glass model of the Knickerbocker mines, electrically illuminated.

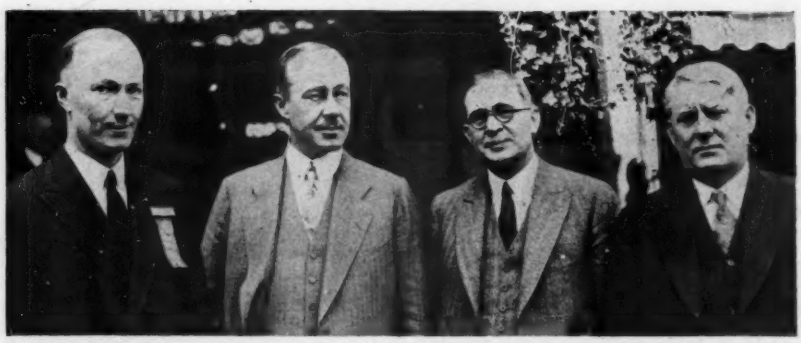
One especially prepared exhibit comprised a collection of fossils which were found in the Coeur d'Alene region, and a meteorite which had fallen nearby. The Washington Brick, Lime and Sewer Pipe Co. had a large display of their products and the different clays from which they are made. Other exhibits included magnesite board and zoualite insulating material. A model furnace, designed to extract metallic values by vaporizing, retorting the vaporized fumes into arsenious oxides and a bullion alloy, was displayed by A. J. Koebel. The exhibition was arranged by Mr. Starmont and A. W. Foster who were engaged in its preparation for three months preceding the convention. Upon the close of the convention the exhibits were given to the Eastern Washington Historical Association for permanent exhibition in the Grace Campbell Memorial Building.

Donald Callahan, Wallace, Idaho, was chairman of the resolutions committee, the other members of which were: W. V. DeCamp, of Jerome, Ariz.: W. W. Bradley, of San Francisco; J. A. F. D. Stone, of Denver; Dan Kelly, of Butte; Joseph Woodbury, of Silver City, N. Mex.; Robert Betts, of Black Butte, Oreg.; H. H. Field, of El Paso; D. D. Moffat, of Salt Lake City; M. D. Leehey, of Seattle, representing Alaska; former Congressman Charles E. Winter, of Wyoming; and Mr. Starmont, of Spokane. Resolutions presented by this committee were adopted as follows:

Land Inquiry

WHEREAS the President of the United States in a communication presented to the Conference of Governors at Salt Lake City, Utah, proposed the appointment of a commission to make a complete survey of the Public Land question of the West, in order that all facts relating thereto may be determined, with a view of placing a check on Federal bureaucracy, a reduction of Federal interference in affairs of essentially local interests, an increase of opportunity of all states to govern themselves, and to obtain better government;

Left to right: Fred A. Starkey, Nelson, B. C., Commissioner of the Associated Boards of Trade of Southeastern British Columbia; Maurice D. Leehey, Seattle, mining counsel and attorney; Dr. Henry Mace Payne, consulting engineer of The American Mining Congress; J. F. Callbreath, secretary of The American Mining Congress; and Frank M. Smith, smelter director of the Bunker Hill & Sullivan Mining & Concentrating Company



Left to right: Russel B. Caples, Superintendent of the Electrolytic Zinc Works of the Anaconda Copper Mining Company, Great Falls, Mont.; James R. Hobbins, Vice President and Director in Charge of Operations of the Anaconda Company; W. C. Rae, Manager of the Tax Department of the Anaconda Company; and Dan M. Kelly, Counsel for Anaconda.

Oregon—Robert M. Betts, Black Butte; and A. W. Strowger, Portland.

South Dakota—B. C. Yates and R. G. Wayland, Lead.

Utah—Oscar Friendly and A. G. Mackenzie, Salt Lake City.

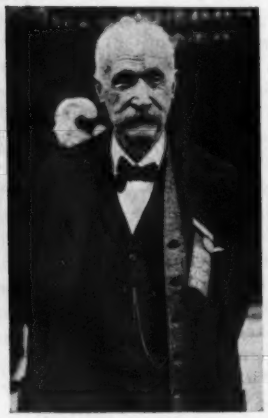
Washington—Frank M. Smith and Leon Starmont, Spokane.

Oklahoma—C. F. Dike, Cardin; and M. D. Harbaugh, Miami.

Alaska — Maurice D. Leehey and Charles D. Garfield, Seattle.

M. P. Dalton, Mill Supt. Morning Mine, Federal Mining & Smelting Co., Mullan, Idaho

R. H. Richards, Jamaica Plains, Mass., known as the "Dean of Ore Dressing"



Chauncey L. Berrien, General Superintendent, Anaconda Copper Mining Company, Butte

Resolved, That we welcome this interest of the President in the problem of our public lands and the conservation of our natural resources and we applaud his expressed desire to assist in checking bureaucracy and aiding in more efficient local government. We endorse the proposal of the appointment of a commission to study these problems and we urge that the personnel of such a commission include one or more persons interested in and acquainted with the problems confronting the mining industry of the West. We await the decision of those vitally interested in agriculture and animal husbandry as to the advisability of turning over to the states the grazing lands referred to by the President, but we express apprehension of any policy which shall separate the surface from the sub-surface rights to our public lands.

State Agreements

Resolved, That we recommend to the American Mining Congress a study, through a committee or otherwise, of the subject of compacts or agreements, by consent of Congress, between any of the States of the Union looking towards the control, conservation and development of natural resources.

Mine Depletion

WHEREAS the present method of computing depletion allowance in the case of new discoveries under our Federal Income Tax law has resulted in insurmountable difficulties of administration, and excessive expense to both Government and taxpayer; and

WHEREAS the further effects of such method have been an instability of income to the Government and a wide inequality of taxation among those engaged in mining; and

WHEREAS the entire subject of depletion is now being considered by the Joint Committee on Internal Revenue Taxation of the Congress of the United States;

Resolved, That we favor an amendment of the present law to provide for the computation of depletion of mines upon the basis of a percentage of net income from the property; and that we recommend to all representatives of the mining industry a study of the report of the staff of the Joint Committee on Internal Revenue Taxation, printed copies of which are now available and may be obtained by application to the committee at Washington.

Blue Sky

Resolved, That we reaffirm our opposition heretofore expressed to the enactment of Federal legislation regulating the sale of securities, commonly known as "Blue Sky Legislation."

At a meeting of the Board of Governors of the Western Division at the Spokane Club on October 1, the present board was reelected as follows:

Arizona—Harry A. Clark, Douglas; and W. B. Gohring, Phoenix.

California—Philip Wiseman, Los Angeles; and G. Chester Brown, San Francisco.

Colorado—Jesse F. McDonald, Leadville; and C. Lorimer Colburn, Denver.

Idaho—Axel P. Ramstedt, Wallace; and Ravenel Macbeth, Boise.

Montana—W. B. Daly and Major C. L. Berrien, Butte.

Nevada—J. C. Kinnear, McGill; and Henry M. Rives, Reno.

New Mexico—J. M. Sully, Hurley; and J. F. Woodbury, Silver City.

El Paso Selected

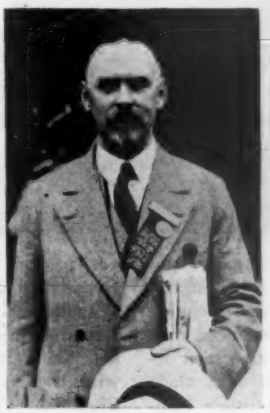
West Texas was admitted to the Western Division by the board on motion of Mr. Woodbury, of New Mexico, and Mr. Rickard was designated the governor of the board for the state with authority to select a state secretary. The board decided to hold the next convention at El Paso upon receipt of invitations from Mr. Rickard, B. L. Berney, president of the El Paso Chamber of Commerce, and R. H. Carrington, vice president of the El Paso Foundry and Machine Company. Major Berrien, of Montana, moved to hold the next meeting at El Paso, which was seconded by Mr. Woodbury, and El Paso was the unanimous choice although invitations had been received from the mayor of Jaurez, Mexico, and from the Sacramento Chamber of Commerce. Mr. Woodbury stated that the mining interests of New Mexico had desired to hold a convention in El Paso for several years, but were prevented because Texas was not represented in the Western Division. He further stated that the New Mexico chapter of the American Mining Congress joined with the mayor, Cham-

ber of Commerce, and others in El Paso in extending the invitation and would assist in the arrangements for the convention. Mr. Rickard was chosen chairman of the Western Division on motion of J. F. Callbreath, secretary of the American Mining Congress, seconded by Major Berrien. The board extended a vote of thanks to Frank M. Smith, retiring chairman of the Western Division for his activities for the year and especially for the thorough manner in which the details of the Spokane convention had been handled. This resolution

Left to right: H. H. Fields, American Smelting & Refining Company, El Paso, Tex.; W. Val De Camp, Assistant General Manager of the United Verde Copper Company, Jerome, Ariz.; I. H. Barkdoll, General Manager of the Old Dominion Company, Globe, Ariz.; C. R. Kuzell, Smelter Superintendent of the United Verde Copper Company, Clarkdale, Ariz.

W. N. Rossberg, Mining and Metallurgical Engineer, Butte, Mont.

Dr. Francis A. Thomson, President of the Montana State School of Mines, Butte



Walter W. Bradley, State Mineralogist of California, San Francisco

was proposed by Ravenel Macbeth, of Idaho, and seconded by Mr. Leehey.

The trip from Spokane to the Coeur d'Alene district in Idaho was made by bus and automobile, visits being made to mines at Burke, Wallace, Kellogg, and Mullan. C. H. Foreman, of Wallace, mining engineer for the Hecla Mining Company, piloted the delegates on an underground trip from Mullan to Burke, a distance of 5 miles, which included a visit to the Morning Mine from Wallace to Mullan. Visits were also made to the Hecla-Star Mine, the Bunker Hill Smelter, the electrolytic zinc plant, and the Bunker Hill Concentrator at Kellogg. While in Idaho the delegates were entertained at lunch at the Tiger Hotel at Burke, and a banquet at Kellogg.

The convention sessions began the morning of September 30 when President Smith of the Northwest Mining Association opened the meeting of that organization. The mining organizations were welcomed to Spokane by its mayor, Leonard Funk, by Governor Rowland H. Hartley, of Washington, and by B. H. Kizer, president of the Spokane Chamber of Commerce. Dr. E. A. Bryan, former president of Washington State College, spoke on "A Background of the Mining Industry of the West," in which he portrayed the early history of the hardy prospectors. Following the close of this session the delegates were entertained at lunch by the Mining Bureau of the Spokane Chamber of Commerce and the Northwest Mining Association. In the afternoon F. C. Moore, vice president of the Northwest Mining Association, presided when addresses on financing mining properties were made as follows: "Investment Trust Idea in Mining," by E. M. Young, vice president, North American Mining and Smelting Corporation; "Blue Sky Legislation," by Dr. James Hance, Dean of Mines, Oregon State College, and former Examiner of Mining Securities for the Illinois Blue Sky Commission; "The Function of Stock Exchanges in Mine Finance," by S. W. Miller, of the Vancouver Stock Exchange; "The Policy of the British Columbia Department of Mines Toward Mining Promotion," by John D. Galloway, of Victoria. In the evening the delegates were guests at a smoker.

Mining Activities

Getting under way the morning of October 1, the sessions of the Western Division continued through October 2. Chairman Smith called the session to order the morning of October 1 and Stanly A. Easton, Vice President and Manager of the Bunker Hill and Sullivan Mining and Concentrating Company, took the chair as presiding officer. Robert E. Tally, of Clarkdale, Ariz., Vice President and General Manager of the United Verde Copper Mining Company and President of The American Mining Congress, was unable to be present, but his address outlining the work of The American Mining Congress was presented by W. Val De Camp, of the United Verde Company. "You enjoy a high standing in the country," said Mr. Tally, "due to your fair and impartial handling of your problems, and as individuals you can assist in this great work by giving freely of your time to the problems that The American Mining Congress may assign you and by encouraging membership in this great mining organization."

Mr. De Camp was followed by George H. Bailey, Counsel of The American Mining Congress, who gave a concise review of pending legislation in Congress effecting the mining industry. "For 32 years The American Mining Congress has served the mining industry of the country as its national representative," he said.

State Mineralogist W. W. Bradley, of California, spoke of "Developing the Non-Metallic Industries of the West," and George Watkin Evans, Consulting Mining Engineer of Seattle, discussed "The Coal Resources of the Northwest." A. P. Ramstedt, of Wallace, Idaho, Controller of the Hercules Mining Company, in speaking on the subject "A Federal Tax Problem," advocated mine depletion allowances based on net income, which he said will stimulate development. Fol-

V 15 11 1 NOV 29 XUM

Left to right: J. M. Doyle, General Superintendent of Great Northern Railway, Spokane; J. D. MacKenzie, Manager of East Helena Smelter of the American Smelting & Refining Co., near Helena, Mont.; Robert Gregg, mine operator, Troy, Mont.; Samuel B. Holbert, mining engineer, Spokane

Left to right: John R. Thomson, mining engineer, Ellensburg, Wash.; John Bridge, mine operator, Pollock, Idaho; Karl O. Kohler, mining engineer, Ellensburg, Wash.; George J. Young, Associate Editor, Engineering & Mining Journal, San Francisco

lowing these addresses the delegates were entertained at lunch by the Spokane Chamber of Commerce at the Spokane Hotel, at which Mr. Kizer and Mr. Easton made addresses.

At the afternoon session on October 1, presided over by Harry L. Day, of Wallace, Idaho, President of the Hercules Mining Company, the public land question and the need for cooperation between mining schools and metal mine operators were discussed. Mark Woodruff, Assistant Supervisor of the Department of Conservation and Development of Spokane, in speaking on "The Federal Public Lands Policy," said the matter of mineral reservations may be safely left in the hands of the investigating commission to be appointed by President Hoover. "The Progress Toward Western Parity" was the subject of an informing address by Judge Charles E. Winter, former Congressman from Wyoming, who advocated State control of public lands. Speaking on the subject "The Dawn of a New Day," J. F. Callbreath, Secretary of The American Mining Congress, asked the West to support the President in his plan to return the public lands to the States. "The American Mining Congress looks ahead to a campaign of 10 or 15 years during which it hopes not only that the Federal Government shall turn over to the States under proper restrictions for the protection of the public, all of its land holdings, except the national forests, monuments, parks, and such other property as is needed for strictly governmental purposes," he said.

Dean Milnor Roberts, of the College of Mines, of the University of Washington, delivered a comprehensive address on "The Need for Cooperation Between the Mining School and the Metal Mine Operator," in training men for positions in the mining industry. "The better organized companies and the successful individual operator not only use care in selecting men for particular positions, but some of them maintain courses of training for them in their service," he said. "The Phelps Dodge Corporation and the United Verde Copper Company put young engineers who enter their employ at their Arizona mines through a course of local training under experienced men in each department. The young men become so thoroughly trained that their services are in demand by other companies." A number of other mining college executives and mining operators participated in a discussion of this subject, including James F. McCarthy, of the Hecla Mining Company; Stanly A. Easton, of the Bunker Hill & Sullivan Mining and Concentrating Co.; Dean A. W. Fahrenwald, of the School of Mines of the University of Idaho; President Francis A. Thomson, of the Montana School of Mines; and Dean A. E. Drucker, of the School of Mines of Washington State College. In the evening the board of governors of the Western Division held a dinner meeting at the Spokane City Club.

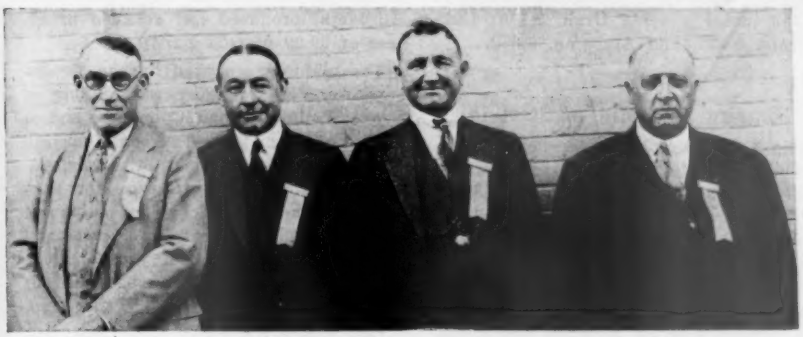
James F. McCarthy, of Wallace, Idaho, President of the Hecla Mining Co., was chairman of the morning session on October 2, at which operating problems of the Coeur d'Alene district of Idaho were considered. Addresses were made as follows: Charles H. Foreman, Mining Engineer, Hecla Mining Co., Wallace, "Mining Methods at the Hecla Mine, including the Star Operation"; M. P. Dalton, and G. S. Price, Mill Superintendent and Assistant of the Morning Mine of the Federal Mining and Smelting Company, of Mullan, Idaho, "Milling Practice at the Morning Mill"; U. E. Brown, Chief Engineer, Bunker Hill & Sullivan Mining & Concentrating Co., Kellogg, Idaho, "Bunker Hill Underground Methods"; R. W. Loyd, Superintendent, Grandview Mines, Inc., Metaline Falls, Washington, "Mining and Milling at Grandview Mines." Following this session the delegates were luncheon guests with the Associated Engineers and Ad Club.

Butte District

The sessions of the Western Division came to a close the morning of October 2 when operating problems in the Butte district were considered, with William B. Daly, Manager of Mines of the Anaconda Copper Mining Co., presiding. A. S. Richardson, Ventilation Engineer of the company, spoke on "Ventilation in the Butte District"; C. L. Berrien, General Superintendent of mines of the company, on "Development and Installation of the Hawkesworth Detachable Bit in Mining Operations in the Butte District"; and by R. B. Caples, General Superintendent of the Great Falls Reduction Department, on "Relation of Anaconda Copper Mining Company's Zinc Operations to Development of Complex Ores in Northwestern States."

The annual banquet held the evening of October 2 at the Davenport Hotel proved a delightful occasion. During the dinner the delegates were entertained with musical numbers and vaudeville sketches. Frank M. Smith presided and Stoddard King was toastmaster. Addresses were made by Mayor Leonard Funk, of Spokane, and President B. H. Kizer, of the Spokane Chamber of Commerce, and brief remarks were made by officials and prominent delegates of the various mining organizations, the evening concluding with dancing.

Left to right: Compton I. White, Manager of Whitedelf Mine, Clark Fork, Idaho; C. A. Coffin, mine operator, Spokane; R. M. Betts, Manager, Black Butte quicksilver mines, Oregon; W. L. Merritt, mine operator, Baker District, Oregon



Left to right: F. Cushing Moore, consulting mining engineer, Spokane; Raymond Guyer, consulting engineer, Spokane; J. W. Mulholland, President of British Columbia Prospectors' Association; James Naughten, Royal Development Company, Leavenworth, Wash.

Sessions of the Columbia Section of the American Institute of Mining and Metallurgical Engineers were held on October 3 with W. L. Zeigler, Chairman of the Section, presiding. A. F. Beasley, Superintendent of the Bunker Hill Smelter, spoke on "Lead Refining Practice at the Bunker Hill Smelter," and A. M. Gaudin, Professor of Metallurgy at the Montana School of Mines, on "The Effect of Xanthate and Copper Sulphate on Sphalerite." At noon the delegates separated and had lunch with the various clubs of the city, at which their presidents welcomed them as follows: Rotary Club, Dr. Ed. Lawrence; Kiwanis Club, H. B. Callison; Lions Club, Dr. H. A. Van Winkle; and Gyro Club, Fred A. Yeager. The Standard Stock Exchange also entertained some of the delegates at the Exchange Building. In the afternoon, R. K. Neil, Vice Chairman of the Columbia Section, presided when addresses were made on "Geophysical Prospecting," by Allen H. Rogers, Consulting Engineer of New York, and J. J. Jakosky, Consulting Engineer of Los Angeles.

Coeur d'Alene Trip

The excursion to the Coeur d'Alene mine district was under the auspices of the Columbia Section and began the morning of October 4. The delegates inspected the Bunker Hill Smelter at Kellogg in the morning after which luncheon was served at the Plymouth Hotel in Kellogg. Afterward visits were made to the electrolytic zinc plant of the Sullivan Mining Co., near Kellogg, and to the Bunker Hill Concentrator. In the evening the delegates were guests at a banquet at Wallace, Idaho, after which a meeting was held presided over by W. L. Zeigler, Chairman of the Columbia Section, at which A. C. Stevenson, Mechanical Engineer of the Hecla Mining Co., of Wallace, spoke on "Vertical Transportation in the Coeur d'Alene," and Wallace G. Woolf, Superintendent, of Kellogg, spoke on the "Operations of the Electrolytic Zinc Plant of the Sullivan Mining Co." On the morning of October 5 the delegates proceeded to Mullan, where they made an inspection of the Morning Star and Hecla Mines, being entertained at Burke at luncheon.

REMOVAL OF SOLUBLE COPPER FROM LEACHED ORES

A study of the factors governing the removal from the ore of the soluble copper salts produced by reactions in leaching has been conducted by the Bureau of Mines at its Southwest Experiment Station, Tucson, Ariz., in cooperation with the University of Arizona. Although the experimentation has been limited to copper ores, the data obtained are applicable to any hydrometallurgical process.

Investigation of the factors involved in the removal of the soluble copper salts produced when copper minerals are leached is desirable because from such a fundamental study one may be able to segregate the fast and slow steps and to devise means of speeding up the slow elements of the process. In Technical Paper 441, issued some weeks ago, there was discussed the necessity for studying some of the fundamentals involved in the leaching of ores—namely, the factors governing the entry of solutions into rocks, the dissolution of the minerals in the ore by suitable reagents, and the bringing out of dissolved mineral salts from the interior of the ore. The first of these is discussed in Technical Paper 441, the second in a series of Reports of Investigations, and the third in Technical Paper 453.

Some conclusions drawn by the authors of Technical Paper 453, by John D. Sullivan and Alvin J. Sweet, which has just been published, are as follows:

For vat washing there is a marked difference in the time of removal of the copper according to the size of the ore particle. In the study of the entry of solution into rocks (Technical Paper 441) the relationship of time of saturation of particle was not linear. The relationship of time of diffusion to size of particle is more nearly linear in the removal of solutions. This increase in time with increase in the size of the particle indicates the desirability of not using too large pieces of ore in leaching.

The temperature studies have shown that approximately 15 per cent more of the total copper is retained in the residue at 2° to 3° C. than at 20° C. after apparent equilibrium is reached. In cold weather it would then be desirable to heat the ore and wash solutions. As the studies of influx of solutions into ore has indicated that a somewhat greater and more rapid penetration is obtained at cooler temperatures, this leads to the belief that in leaching it would be desirable to add the leaching solutions at night and the wash solutions in the daytime when it is warmer.

Copies of Bureau of Mines' Technical Paper 453, "Factors Governing Removal of Soluble Copper from Leached Ores," may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at a price of 15 cents.

Fatality Rate in Metal Mining Industry Reduced in 1928

During 1928 there were 273 men killed and 22,483 injured in the metal and non-metallic mineral mines of the country, according to a statistical compilation made by the United States Bureau of Mines. The fatality and injury rates per thousand 300 day workers were 2.50 and 205.62, respectively, the fatality rate being reduced 19 percent and the injury rate 7 percent below the rates which prevailed in the preceding year. A total of 113,866 men were employed in the metal mining industry in 1928, which is 5,833 less than for the preceding year. These workers performed 32,803,610 man days of labor, which is 1,230,353 less than in 1927.

The highest fatality rate, 3.03 per thousand 300-day workers, was in the copper mining industry, in which 30,561 men were employed by 213 operators. In the gold and miscellaneous metal industries 31,622 men were employed by 2,196 operators, the fatality and injury rates being 2.60 and 268.72, respectively. In the iron mining industry 29,145 men were employed by 99 operators, the fatality and injury rates being 2.16 and 98.13. In the lead and zinc mining industries of the Mississippi Valley, 10,334 men were employed by 85 operators, with fatality and injury rates of 1.62 and 295.65. In the non-metallic mineral industries, 12,204 men were employed by 249 operators, the fatality and injury rates being 2.13 and 168.60.

Of the total number of workers, 70,188 were employed underground, 29,378 on the surface, and 14,300 in open pits. In underground work 227 were killed, in surface work 31 met death, and in open pits 15 were fatally injured. The fatality and injury rates were: Underground, 3.33 and 264.74; surface, 1.12 and 114.48; open pit, 1.12 and 92.90.

Falls of rock or ore from roof or wall was the greatest single cause of fatal injury to underground workers, accounting for 84 deaths. Haulage accidents caused 26 deaths, explosives, 19, and falls down chute, winze, raise or stope, 18. Shaft accidents accounted for 41 deaths.

The greatest number of workers employed in the metal mining industry of any state was 15,329 in the copper and iron mines of Michigan. Arizona employed 11,771 men, mainly in its great copper industry. Minnesota, with its extensive open pit iron mines, employed 10,635 workers. Montana employed 9,412 metal miners; Utah, 7,195; California, 6,433, and Alabama, 6,052.

Empire Zinc Mill to Start in December

Operation of the new 500-ton flotation mill, built by Empire Zinc, a subsidiary of New Jersey Zinc Company, at Belden, Colo., will probably start in December in spite of the fact that recent heavy rains have slowed up the work. Because Eagle River Canyon is too narrow to permit construction of a large plant, the Empire mill is being built entirely underground. In addition, partial prevention of the slight oxidation which results from exposure of the ore to air is expected to make flotation treatment easier. The cost of the new plant has been estimated at $1,500,000.

The mill is about 100 ft. below the Newhouse tunnel and will extend along the face of Battle Mountain for 400 ft., about 150 ft. from the surface. Ore pockets to hold ore from the Newhouse tunnel will be constructed above the mill.

Evans-Wallower Electrolytic Zinc Plant Producing Fifty Tons of Metal Daily

Announcement was made October 20 by the Evans-Wallower Lead Company, of the successful starting of its electrolytic zinc plant at East St. Louis, Ill. The roasters were started early in September and power was switched on the cell room on September 23. Output of cathode zinc at the beginning was 25 tons per day and production has now been increased to the rated capacity of 50 tons daily. No difficulties of any kind were experienced in the functioning of the Tainton process and as a result of recent developments in the research laboratory plant performance has so far exceeded expectations. The new reagent developed by U. C. Tainton has been effective in preventing excessive atmospheric spray in the cell room, which until recently has been a serious difficulty with electrolytic zinc plants.

The melting furnace was placed in operation on October 19 and slabs carrying the trade name Evanwall were cast in preparation for shipment. Carload lots are now being shipped to consumers in the die casting and brass industries. All metal produced has assayed in excess of 99.99 percent purity.

The plant is operated by the Evans-Wallower Zinc Company, a subsidiary of Evans-Wallower Lead Company, and is located adjacent to that of the Monsanto Chemical Works at East St. Louis, delivering sulphur gas to the Monsanto plant for the manufacture of sulphuric acid. Ground was broken for construction on October 1 of last year and the elapsed time is considered a record in the building of a new plant of this kind.

The Evans-Wallower Lead has announced the erection of an electrolytic lead plant on the same location, which will be started about December 1. This plant will recover lead values from the residues of the zinc plant and will make a product which will be suitable for conversion into litharge and red lead in the Charleston plant of the company.

Five Mines of the Tri-State Have Gone Through 1929 Without Lost-Time Accident

Five mines of two companies in the Tri-State district have worked through the first nine months of 1929 without a lost-time accident. The mines are the Beaver, Grace Walker, Jay Bird, and Webber, of the Commerce Mining and Royalty Company, and the No. 24 mine, of the Evans-Wallower Lead Company.

Two mines, the Webber and Jay Bird, of the Commerce Mining and Royalty Company, have worked more than two years without a lost-time accident, and the Webber is within three months of completing its third accidentless year, according to Henry Giessing, safety engineer.

Employes of the Webber mine have worked 36,307 consecutive man-shifts in the years 1927, 1928, and 1929, without a lost-time accident.

The Jay Bird mine completed its second year without a lost-time accident on October 2, when it had piled up a record of 23,617 consecutive man-shifts without a lost-time accident.

The Commerce company is offering a bonus to each man in the organization

working at a mine that finishes the year without a compensable accident and at present seven mines are in the running for the bonus.

Records of the accident prevention department of the Tri-State Zinc and Lead Ore Producers' Association show that 50 mines of companies reporting to the organization went through September without a lost-time accident.

Seventy-one mines of 19 companies reporting to the accident prevention department of the Tri-State Zinc and Lead Ore Producers' Association worked 27,725 man-shifts in the week ending October 19 without a lost-time accident.

Compressor Building and Main Office of Admiralty Zinc Company Burn

Fire of undetermined origin destroyed the compressor building and main office of the Admiralty Zinc Company, in the west part of Douthat, Okla., October 3. The loss was $50,000 to $75,000. Part of the loss was covered by insurance.

About a dozen shafts are dependent on the compressor plant for power to operate drilling machines and the fire put between 200 and 300 men out of employment.

The power unit was completely rebuilt and mines which were on the inactive list resumed operation October 25.

Otis Mining Company Building Mill at Baxter Springs

A new 200-ton mill is being built by the Otis Mining Company, northwest of Baxter Springs, Kans. The plant is being constructed so that with little additional expense it can be converted into a 350-ton plant.

Equipment of the mill will consist of a 6-cell rougher and a 7-cell cleaner jig and six sludge tables. Room will be left for a float plant which will not be needed until the lower run of ore is mined. The plant will be operated by electricity.

A second shaft is being sunk on the lease which will be ready by the time the mill is completed. The first shaft was sunk to the 115-ft. level where a rich run of ore has been developed by drifting. A shallower run has been developed on the 115-ft. level. The second shaft will be sunk to the 220-ft. level, where a third run of ore is indicated by drilling.

Ore Mining on Mesaba Range to Remain Active

Indications that the ore mining season on the Mesaba Range of Minnesota will continue active this winter and next year is seen in the announcement being made by various mining companies of resumption of operations of properties which had been closed for some time.

The Wade mine, owned by the Cleveland-Cliffs Company, located at Kinney, which has not been operating since 1921, resumed operations recently with Capt. Thomas Wivell in charge. Shipments to date at the Wade property exceed 500,000 tons.

Stock piles at the South Agnew mine, located west of Hibbing, have practically all been removed this summer and one of the most active shipping seasons in years for this property is coming to a close. The South Agnew mine stockpiles during the winter months and when spring opens up, this ore is shipped to the Head of the Lakes.

The South Agnew employed a number of men this year and is one of the most active of underground properties. A new timber shaft was built this year and a new rail line to the property has been completed.

Minnesota Mine Rentals, Royalties Up to $1,500,000

State Auditor Ray P. Chase, of Minnesota, reports that for the quarter ending September 30, the mining companies holding leases on state lands paid into the trust funds of the state more than $1,500,000 in royalties and rentals.

This is the largest amount ever paid for ore removed in any one quarter in the history of mining on state owned lands.

The largest single check was for $796,959.29, and come from royalty on ore removed from the Missabe Mountain mine.

The total tonnage of ore removed during the quarter was 6,004,008 tons. The shipments from state lands for 1929 have to date passed all years, even the banner year of 1926, when 10,017,638 tons were forwarded. As the shipments reported to the state auditor as of October 14, amounted to 10,021,000 tons, the promise for the 1929 season being the largest ever is fulfilled. With several weeks of shipping weather left, the state-owned mines may be expected to close the season with a tonnage close to 11,000,000 tons.

The total shipment of all the mines of Minnesota for the season 1929 may reach 44,000,000 tons, hence it is likely that the mines leased from the state will furnish 25 percent of all ore produced this year. In 1928 the state's mines forwarded 8,848,814 tons out of a total of 36,504,854 tons for the entire state.

R. L. Agassiz Again Heads Copper & Brass Research Association

R. L. Agassiz, chairman of the Board of the Calumet & Hecla Consolidated Copper Company of Boston, was re-elected president of the Copper & Brass Research Association at the ninth annual meeting of that organization held at its offices in New York.

Two additional producing member companies were admitted to membership. They are Copper Range Company and The Granby Consolidated Mining, Smelting & Power Company, Ltd.

At a meeting of the Board of Directors the following officers were elected: President, R. L. Agassiz; vice presidents, F. S. Chase, Walter Douglas, H. Donn Keresey, Thomas D'A. Brophy; treasurer, Stephen Birch.

William A. Willis, who has managed the association since its formation, was reelected to that position; Bertram B. Caddle was reelected secretary.

Copper Queen Company Putting California Rand Silver on Producing Basis

Ore and concentrates are being shipped regularly from the California Rand Silver or Kelly mine, Ransburg, Calif., recently taken over by the Copper Queen Mining Company, which is operating also near Battle Mountain, Nev.

H. W. Gould, of San Francisco, whose engineering staff is directing operations of the Copper Queen Company, says that considerably more ore is being broken and stored in the mine than is being milled. The mill is now treating approximately 60 tons per day and it is expected that this will be increased shortly to 100 tons daily.

Old Workings of Silver Reef Mine Unwatered

Mines under water at the old camp of Silver Reef in Washington County, Utah, for nearly 50 years, have been pumped dry and sampling by the engineering staff of the American Smelting and Refining Company is now under way, according to A. H. Means, manager of the western mining department.

Unwatering of the California shaft has been completed to the bottom about 800 ft. on the incline. A few old winzes remain to be pumped dry but work of sampling and mapping the old stopes is proceeding.

Sheldon Mining Co. Blow-in Smelter

The Sheldon Mining Company has announced that its smelter at Humboldt, Ariz., will blow in during December.

The reverberatory furnace will handle about 200 tons of concentrates a day, of which possibly 50 tons will come from the Sheldon mill at Walker, on upper Lynx Creek.

The Sheldon mine now is hoisting about 100 tons of ore a day, carrying copper, in chalcopyrite, as well as gold,

silver and lead. One hundred men are employed. The company also has acquired control of the De Soto and Blue Bell mines near Mayer, from Southwest Metals Company, former owner of the smelter, which secured its main ore supply from the two properties.

Silver Producers Hold Annual Meet

The annual meeting of the American Silver Producers' Association was held in Salt Lake the middle of October. The election by ballot some time ago of W. Mont Ferry as president, was ratified as was the election of other officers of the association. The other officers are Frank M. Smith, Washington, vice president; Robert E. Talley, Arizona, second vice president; Henry M. Rives, secretary-treasurer.

The board of directors of the association will meet later in New York and probably discuss the silver tariff, it is said.

John Fritz Medal Awarded to Ralph Modjeski

"For notable achievement as an engineer of great bridges combining the principles of strength and beauty," Ralph Modjeski, native of Poland, has been awarded for 1929, the John Fritz Gold Medal, highest of American engineering honors.

The choice, which was unanimous, was made by the John Fritz Medal Board of Award, composed of 16 recent past presidents of the four national societies of civil, mining and metallurgical, mechanical, and electrical engineers, which have a combined membership of nearly 60,000.

The members of the board making the award were:

American Society of Civil Engineers—Robert Ridgway, George S. Davison, John F. Stevens, Lincoln Bush. American Institute of Mining and Metallurgical Engineers—J. V. W. Reynders, Samuel A. Taylor, E. De Golyer, George Otis Smith. American Society of Mechanical Engineers—D. S. Jacobus, Dexter S. Kimball, Charles M. Schwab, Alex Dow. American Institute of Electrical Engineers—M. I. Pupin, C. C. Chesney, Bancroft Gherardi, R. F. Schuchardt.

W. C. Capron Leaves Anaconda Reduction Works

W. C. Capron, Anaconda, Mont., has resigned as mechanical superintendent of the Anaconda Reduction Works, which position he has occupied for the past 14 years. Mr. Capron has been considering such a move for some time in order to devote his time to personal interests and to travel.

Mr. Capron has been with Anaconda Copper Mining Company since it was incorporated, previous to that time being employed with the Boston Montana Mining Company, with which he started in 1897 with headquarters in Great Falls, where he was a draftsman. He and Mrs. Capron recently returned from a tour of the world and expect to leave in the near future for California.

Silver Producers Lose Suit

The U. S. Supreme Court has declined to review a decision of the District of Columbia Court of Appeals which refused to grant a mandamus sought by the American Silver Producers Association to require the Treasury Department to purchase 15,000,000 ounces of silver at $1 per ounce to complete transactions under the Pittman act. The effect of the action is to end the litigation which began several years ago and to sustain the Treasury. The silver interests had claimed that this amount of silver had been allocated for subsidiary coinage and should be made up by new purchases. The issue was commenced when Senator Pittman (Dem., Nev.), conducted an investigation for the Senate Gold and Silver Commission which revealed the allocations and their subsequent revocation, which was sustained by the Comptroller General. The Senate at two sessions passed a bill for the purchase of this silver, but the House never acted on them. The lower courts held that the association did not have sufficient interest to bring the suit. As is usual in such case, the Supreme Court in declining to review the case rendered no opinion, simply announcing its declination, which has the effect of upholding the lower courts and of ending the case.

TRI-STATE ZINC & LEAD PRODUCERS HOLD ANNUAL MEETING AT PICHER

An effort to extend the zinc schedule in the tariff bill now pending in the United States Senate to include zinc ores containing less than 10 percent metallic zinc, was approved at the sixth annual meeting of the Tri-State Zinc and Lead Ore Producers' Asssociation, held at Picher, Okla., October 7.

In a letter to A. Scott Thompson, legal advisor of the association, which was read at the meeting, J. D. Conover, secretary of the American Zinc Institute, stated that unless the present bill was amended to cover the lower grade ores, the domestic zinc industry was liable to lose an amount of business equal to 700 tons of Tri-State concentrates a week.

According to Conover, if a project now in the making is consummated, a large mining venture will be inaugurated in Canada, near the United States border, in which a vast amount of low grade ore, assaying less than 10 percent metallic zinc, and consequently duty free under the pending tariff act, would be mined and shipped across the American border to be smelted.

Thompson stated that the situation looked serious and that he advised that the association ask the Senators from the three states in which the Tri-State district is located—Missouri, Kansas and Oklahoma—to confer with the officials of the American Zinc Institute to see if some way of amending the tariff section could not be worked out.

Two Congressmen, J. J. Manlove of Missouri, and Charles O'Connor of Oklahoma, offered their services in aiding the operators in obtaining an adequate tariff, one that they felt the industry was entitled to.

The association passed a resolution offered by M. F. Owens and seconded by W. T. Landrum, which asked the Senators of the three states to confer with the officials of the American Zinc Institute.

President Frank Childress stated that he was confident that the officials of the institute were in close touch with the situation and would do all in their power to obtain an adequate tariff for the industry in a manner the situation deemed best.

In opening the meeting, President Childress stated that the industry was facing a serious condition. With complete cooperation, he asserted, the industry could be stabilized on a profitable basis.

The vast amount of work done by the organization was conveyed in the annual report made by M. D. Harbaugh, secretary. The association has been confronted by various legislative matters in the three state legislatures and, in addition, with the tariff and depletion clauses in Congress. The proposed revision of the freight rate structure on zinc and lead freight rates before the Interstate Commerce Commission is being handled by the association, which is working with the American Zinc Institute.

The report of the treasurer, Charles A. Neal, showed the organization in a sound financial position, with more than $40,000 in cash on hand.

Fred Nesbitt, safety engineer, outlined the work of the accident prevention department for the last year. Dr. F. V. Meriweather reported on the work of the Tri-State clinic, and Richard Jenkins on the progress of the welfare department of the association. Victor Rakowsky

stressed the need of an immediate market broadening program.

Frank Childress, president of the Mid-Continent Lead and Zinc Company, was reelected president of the association at a meeting of the newly elected board of directors held October 18. S. H. Davis, manager of the Century Zinc Company, was reelected first vice president. F. C. Wallower, general manager of the Evans-Wallower Lead Company, was elected second vice president to succeed Edgar Wallower, who moved to New York City during the year. Charles Neal was reelected treasurer and M. D. Harbaugh, secretary.

The newly-elected board of directors consists of F. N. Bendelari, Consolidated Lead and Zinc Company; Frank Childress, Skeleton Lead and Zinc Company; S. H. Davis, Century Zinc Company; C. F. Dike, Interstate Zinc and Lead Company; P. W. George, Federal Mining and Smelting Company; A. M. Gaines, New Chicago Mines Corporation; W. T. Landrum, Cortez-King Brand Mines Corporation; T. F. Lennan, Quapaw Mining Corporation; C. A. Neal, Roberts Milling Company; C. W. Nicolson, Canam Metals Corporation; M. F. Owens, Black Eagle Mining Company; George W. Potter, Eagle-Picher Lead Company; George Provine, Tulsa Lead and Zinc Company; John Robinson, Commerce Mining and Royalty Company, and F. C. Wallower, Evans-Wallower Lead Company.

TIMELY MINING PROBLEMS TO BE CONSIDERED AT MINING CONGRESS CONVENTION IN DECEMBER

Timely topics of interest to the mineral industry of the nation will claim the attention of delegates to the annual convention of the American Mining Congress at Washington, Dec. 4 to 7. Robert E. Tally, of Clarkdale, Ariz., vice president and general manager of the United Verde Copper Mining Company, the president of the organization, is drafting the detailed program in cooperation with the directors and the Washington office, headed by J. F. Callbreath, secretary.

Because of the widespread interest in the plans of President Hoover looking to the transfer of the public lands of the West to the states through an investigation and report to be made by a commission named by him, the convention is expected to devote attention to the question in view of its effect on the mineral development of these areas. Mineral taxation will also come in for discussion in connection with a recent report to the Joint Congressional Committee on Internal Revenue Taxation favoring the application of mine depletion on the basis of a percentage of net income. It is expected the convention will receive a report on this question from the General Tax Committee of the American Mining Congress, of which Paul Armitage, of New York, is chairman.

Advances made by the coal mining industry in mechanization will be considered by the convention which will receive a report from Dr. L. E. Young, of the Pittsburgh Coal Co., on the work of the National Committee on Mechanized Mining, of which he is chairman. The coal industry and trends in business will be other themes for discussion.

Erskine Ramsay, of Birmingham, president of the Alabama By-Products Company, will preside over a meeting of the Board of Governors of the Southern Division of the American Mining Congress to be held during the convention. At this meeting decision will be reached as to the time and place for holding the Industrial Development Conference under the auspices of the Southern Division in a southern city in the early spring of 1930.

American Mining Congress Timbering Committees Combined

The Mine Timbering Committees of the coal and metal mining branches of the Standardization Division of the American Mining Congress have been combined and enlarged to include representatives of all interests desiring participation in development of a national standard covering preservative treatments of mine timbers. The new committee is made up of the following:

George M. Hunt, in charge of the Section of Wood Preservation, Forest Products Laboratory, Madison, Wis., chairman; R. L. Adams, chief engineer, Old Ben Coal Corporation, Christopher, Ill.; W. L. Affelder, assistant to the president, and M. E. Haworth, chief engineer, Hillman Coal and Coke Co., Pittsburgh, Pa.; R. W. Austin, American Mond Nickel Co., Clearfield, Pa.; Dr. H. C. Gardiner, Anaconda Copper Mining Co., Anaconda, Mont.; J. H. Hensley, Miami Copper Co., Miami, Ariz.; J. L. Hyde, mine timber department, Cleveland-Cliffs Iron Co., Ishpeming, Mich.; J. C. Quade, chief engineer, Saline County Coal Corporation, Harrisburg, Ill.; M. H. Sellers, timber agent, Chicago, Wilmington and Franklin Coal Co., Carbondale, Ill.; D. A. Stout, Colorado Fuel and Iron Co., Pueblo, Colo.; C. N. Kerr, American Wood Preservatives Association, Chicago, Ill.; Gerald Sherman, consulting mining engineer, Phelps Dodge Corporation, Douglas, Ariz.; J. A. Helson, Joyce-Watkins Co., Metropolis, Ill.; D. C. Jones, general superintendent, Ayer and Lord Tie Co., Chicago, Ill.; H. E. Tufft, Grasselli Chemical Co., Cleveland, Ohio.

Chairman Hunt has outlined a program which contemplates a review of existing specifications, including those of the American Wood Preservers Association, and the inclusion in whole or in part of such of these as are applicable to mining conditions and the development of additional specifications and recommendations as needed.

As these specifications are being developed under the procedure of the American Standards Association, sponsored by the American Mining Congress as national standards, every one having an interest in the project is invited to communicate with the secretary of the committee, J. M. Hadley, at the headquarters of the American Mining Congress at Washington, D. C.

C. F. Kelly Awarded M. & M. Society Gold Medal

The Gold Medal of the Mining and Metallurgical Society of America has been awarded to Cornelius F. Kelly, president of the Anaconda Copper Mining Company for "distinguished services in expanding and stabilizing the industry." The presentation was made October 22, at a reception in New York.

Mid-Continent Lead & Zinc Co. Takes Group Insurance

Employes of the Mid-Continent Lead and Zinc Company, of Picher, Okla., are participating in the benefits of a double coverage group insurance program through contract made by their employer with the Metropolitan Life Insurance Company. The premiums on the more than $100,000 life insurance and sick and accident insurance involved will be paid jointly by the employer and employes.

Each subscribing rank and file employe will receive $1,500 of life insurance, and sick and accident benefits of $10 a week. These weekly payments will be made when an employe is unable to work.

NATIONAL COAL ASSOCIATION MEETS IN CINCINNATI

C. E. Bockus, president and chairman of the Board of Directors of the Clinchfield Coal Corporation, New York City, with operations in Virginia, was elected president of the National Coal Association at the closing session of the twelfth annual meeting of the organization, held in Cincinnati, October 23, 24 and 25. Since 1918 Mr. Bockus has been a director of the association and since 1924 he has acted as treasurer.

Other officers elected at the meeting were:

Vice-Presidents—W. H. Cunningham, president, Traux-Traer Coal Co., Chicago, Ill.; J. W. Searles, president, Pennsylvania Coal & Coke Corp., New York City; Rice Miller, vice-president, Hillsboro Coal Co., Hillsboro, Ill.; J. F. Welborn, chairman of the board, Colorado Fuel & Iron Co., Denver, Colo.

Treasurer—W. D. Ord, president, Empire Coal & Coke Co., Landgraff, W. Va.

Executive Secretary—Harry L. Gandy, Washington, D. C.

The following directors were elected or re-elected:

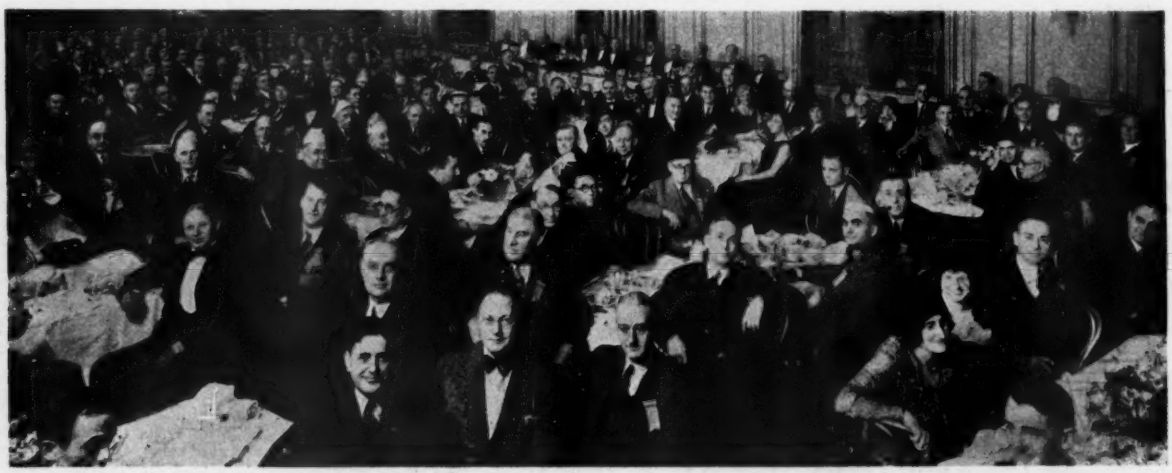
Geo. J. Anderson, president, Consolidation Coal Co., New York City; J. G. Bradley, president, Elk River Coal & Lumber Co., Dundon, W. Va.; J. E. Butler, general manager, Stearns Coal & Lumber Co., Stearns, Ky.; W. J. Cunningham, president, Crummies Creek Coal Co., Crummies, Ky.; C. C. Dickinson, president, Dry Branch Coal Co., Charleston, W. Va.; Wm. Emery, Jr., president, Cambridge Collieries Co., Cleveland, Ohio; Michael Gallagher, president, Northwestern Mining & Exchange Co., Cleveland, Ohio; C. F. Hamilton, president, Pyramid Coal Corp., Marion, Ill.; C. H. Jenkins, vice-president, Hutchinson Coal Co., Fairmont, W. Va.; F. S. Love, president, Union Collieries Co., Oliver Bldg., Pittsburgh, Pa.; Rice Miller, vice-president, Hillsboro Coal Co., Hillsboro, Ill.; Otis Mouser, president, Stonega Coke & Coal Co., Philadelphia, Pa.; J. B. Pauley, chairman of the board, Miami Coal Co., Chicago, Ill.; W. L. Robison, vice-president, Youghiogheny & Ohio Coal Co., Cleveland, Ohio; J. W. Searles, president, Pennsylvania Coal & Coke Corp., New York City; Jas. B. Smith, president, Spring Canyon Coal Co., San Francisco. Calif.; A. B. Stewart, president, Davis Coal & Coke Co., Baltimore, Md.; J. F. Welborn, chairman of the board, Colorado Fuel & Iron Co., Denver, Colo.; J. P. Williams, Jr., vice-president, Koppers Coal Co., Pittsburgh, Pa.; Geo. J. L. Wulff, president, Western Coal & Mining Co., St. Louis, Mo.

C. E. Bockus, newly elected president of the National Coal Association

The meeting was splendidly attended and the program embraced a most interesting array of addresses. The proceedings of the meeting are to be published by the association early in November. Following are some of the papers presented to the meeting, which will be carried in full in the proceedings: "Automatic Heat," by Lorin W. Smith, Jr., Minneapolis-Honeywell Regulator Co.; "Some Observations in Retail Coal Merchandising," by Milton E. Robinson, Jr., president, National Retail Coal Merchant's Association; "A Discussion of Mine Safety," by W. L. Robison, vice-president, Youghiogheny & Ohio Coal Co.; "Safety Progress in Mines of Rocky Mountain District," by W. D. Brennan, manager, Stag Canon Branch, Phelps Dodge Corp.; "The Producers' Marketing Problems," by J. B. Pauley, chairman of board, Miami Coal Co.; "A Salesman's Knowledge of General Conditions," by J. W. Searles, president, Pennsylvania Coal & Coke Corp.; "The Export Situation," by W. T. Coe, director of distribution, Consolidation Coal Co.; "Larger Marketing Units," by W. H. Cunningham, president, Truax-Traer Co.; "Recent Federal Taxation," by Sidney P. Simpson, of Hines, Rearick, Dorr, Travis & Marshall; "The Legislative Situation Today," by W. H. Coolidge, chairman of board, Island Creek Coal Co.; "The Distinction Between Government and Business," by Col. W. M. Wiley, vice president, Boone County Coal Corp.; "Anti-Injunction Legislation," by Walter Gordon Merritt, counsel for the Anthracite Operators' Conference.

In addition to the foregoing there were reports presented by former president E. C. Mahan, Executive Secretary Harry L. Gandy, and Walter Barnum, chairman of the Market Research Institute, the latter including a survey of the trade practice movement in the industry.

The annual meeting of the Illinois Mining Institute will be held at Danville, Ill., in the Grier-Lincoln Hotel on November 8 and 9, 1929. The meeting will be called to order by President John E. Jones at 9.30 a. m., and in addition to the routine matters, election of officers, etc., there are some proposed changes in the by-laws to be acted upon.



The National Coal Association Banquet, held the evening of October 24, in the Sinton Hotel, Cincinnati

West Virginia Coal Mining Institute To Meet November 26 and 27

The twenty-second annual meeting of the West Virginia Coal Mining Institute will be held in Fairmont, W. Va., at the Fairmont Hotel, Tuesday and Wednesday, November 26 and 27, it is announced by Professor C. E. Lawall, head of the School of Mines of West Virginia University, and president of the Institute.

The first day will be taken up with technical papers and the second day will be given over to inspection trips to the Owings Mine of the Consolidation Coal Company and the Barrackville Mine of the Bethlehem Mines Corporation. The annual banquet will be held on the evening of the 26th.

The executive committee together with Professor Lawall, includes Josiah Keely, general manager of the Cabin Creek Consolidated Coal Company of Kayford; W. E. E. Koepler, secretary of the Pocahontas Coal Operators' association, Bluefield; J. W. Bischoff, general manager of the West Virginia Coal and Coke Corporation, Omar; Thomas J. Ear, general manager of the Consolidation Coal Company, Fairmont; and E. L. Griffith, district mine inspector.

Anthracite Institute Organized

Announcement of the creation of the Anthracite Institute was made recently by its President, S. D. Warriner, president of the Lehigh Coal & Navigation Company, and Eliot Farley, chairman of the executive committee. Included in its membership are the heads of every big hard coal company and every large individual anthracite operator.

The Institute will establish headquarters at once and will proceed to carry out a constructive program which has for its purpose:

1. To keep the consuming public thoroughly posted on all developments in the anthracite industry, with special reference to the research work now conducted for the benefit of both domestic and commercial consumers.

2. To protect anthracite users against unfair practices.

3. To promote the best interest of the anthracite industry and all engaged therein.

In announcing the formation of the Anthracite Institute, Mr. Warriner made the following statement:

"Although one of the very definite reasons for organizing the Anthracite Institute was to keep the consuming public informed on all developments in the industry, it will be considerably more than a clearing house for information. To consumers and the producers and dealers in the industry itself, it will be a barrier of protection against unfair practices prejudicial to public interest.

"To begin with, both the public and dealers are to be protected against unfair discrimination. The members of the Institute will maintain strict standards for the sizing and preparation of anthracite coal to the end that anthracite may be sold and bought with the assurance that it conforms to the description under which it is sold.

"All persons who have made any study of the anthracite industry's problems will concede, I believe, that their solution is dependent for the most part upon greater efficiency in production and better adjustment to the domestic market. It is to help speed up this efficiency and adjustment that the Anthracite Institute has been created.

"Supplementing its administrative work, the Institute will maintain research laboratories at Norristown, Pa., where continual experiments will be made to further the development of equipment for using anthracite coal, so as to afford the anthracite user the same degree of convenience that can be secured in using any other fuel. Work along these lines is already going on at the laboratories. We want to do everything possible to give the consumer the highest grade of coal, help him get the greatest possible combustion value from it and make it as easy as possible for him to use it.

"The work of organizing the Institute has been going on for several months. The undertaking is based upon the fundamental principle of service to the consumer and the fact that well directed research work can immeasurably aid to the comfort and convenience of the consumer."

The executive committee of the Anthracite Institute includes: S. D. Warriner, president, The Lehigh Coal & Navigation Company; Eliot Farley, president, The Delaware, Lackawanna & Western Coal Company; A. J. Maloney, president, The Philadelphia and Reading Coal & Iron Co.; R. F. Grant, president, Lehigh Valley Coal Corporation; F. W. Leamy, senior vice president, the Hudson Coal Co.; Michael Gallagher, president, the Pennsylvania Coal Co.; Percy C. Madeira, Jr., vice president, Madeira, Hill & Co.; D. Markle, president, Jeddo-Highland Coal Co., and Hazle Brook Coal Co.

Kanawha Coal Operators' Association Holds Annual Meeting

Unveiling of a portrait of the late Col. John Q. Dickinson, first president of the Kanawha Coal Operators Association, an expression of appreciation of the 25 years of continuous service given to the association by Duncan C. Kennedy, executive secretary, and the election of officers were the features of the annual meeting of the association held at the Kanawha Country Club, Charleston, W. Va., October 17.

Col. W. M. Wiley, of Sharples, vice president and general manager of the Boone County Coal Corporation, was re-elected president; Frank O. Harris, of the Cannelton Coal and Coke Company was re-elected vice president; D. C. Kennedy was re-elected executive secretary, and John L. Dickinson was re-elected treasurer. Colonel Wiley was unable to be present at the annual meeting, his physian ordering him home because of the infection of an ankle.

At the annual business session of the association held during the forenoon Vice President Frank O. Harris presided and the annual report of Secretary Kennedy was made, including a discussion of compensation insurance. Attorney A. M. Belcher and others discussed the proposed legislation in the Federal congress limiting the writ of injunction.

The principal speaker at the banquet held in the evening was James L. Davidson, of Birmingham, Ala., an attorney of that city, who, for 17 years has been the secretary of the Alabama Mining Institute.

In the absence of Colonel Wiley, E. W. Knight presided at the banquet, introduced the speakers and paid a tribute to the late Colonel Dickinson, the first president of the association, who died in November, four years ago.

Among the speakers were John Laing, former president of the association, and C. B. Huntress, assistant to the secretary of the National Coal Association.

D. C. Kennedy, secretary of the association, was presented by Mr. Knight with a silver service given by the association in appreciation of his quarter of a century of service.

Pennsylvania Operators and State Officials Effect Agreement to Prevent Stream Pollution

An agreement was effected October 10 at Harrisburg between the Sanitary Water Board of Pennsylvania and representatives of the bituminous coal industry of Pennsylvania relative to cooperative studies of the uses of streams in the western part of the state. The coal companies involved represent 52½ percent in the bituminous region. The purpose of the study is to preserve unpolluted streams and to improve those now polluted. The agreement creates the bituminous coal mine drainage board of Pennsylvania, composed of state officials, headed by Dr. Theodore B. Appel, secretary of health, and representatives of the bituminous coal industry. The signatories to this agreement on the part of the bituminous coal industry represent 46 coal companies, with an annual tonnage of 68,700,000.

Final Evidence Taken in Temple Coal Case

The Federal Trade Commission took final evidence at Wilkes-Barre, Pa., October 15, in its complaint against the Temple Anthracite Coal Company, of Scranton, for alleged violation of the Clayton anti-trust act. Its next step will be a decision in the complaint originating October, 1928.

The commission's action was brought against the company for alleged lessening of competition through the acquisition of the Temple Coal Company, and the East Bear Ridge Colliery Company.

Lawyers for the defendant admitted ownership of the two mining concerns, but denied that they had ever entered into competition with each other. The output of each was sold at the mines to separate coal dealers, attorneys said, denying that the Temple Anthracite subsidiaries were shippers in any sense.

John P. Kelly, who made the principal argument for the defendant, also questioned the commission's jurisdiction in the matter, citing the contention that the companies did not deal in inter-state traffic and were not subject to Federal regulations as a consequence.

E. L. Smith, attorney for the commission, asserted that the Thorne Neal Company, and the Madeira Hill Company, purchasers of the output of the Temple Coal and the East Bear Ridge, respectively, were virtually agents of the latter concerns, and did not mitigate the contention that they shipped in interstate commerce.

The commission announced that the case will be taken under advisement. No indication as to what decision may be expected was given.

Powdered Coal Boat Makes Record Trip Across the Atlantic

The Todd Shipyards Corporation recently made public a report regarding the performance of the West Alsek, reputed to be the first vessel to make a trans-Atlantic voyage depending only on pulverized coal. The report states "the average speed was increased by 9 percent over its former performance when hand fired.

"The total power required to operate the mills, elevators, crushers, screw conveyor and magnetic separators was 2.19 percent of the total horsepower, while the total steam consumed by all the coal burning gear was only 5.36 percent of the total evaporation of all boilers.

"As a hand-fired job this ship burned 464 pounds of coal per mile with a speed of 8.78 knots and 1,790 I. H. P. The coal was of a mine run which costs $4.80 per ton trimmed in the bunker; the cost per mile was therefore $.994. As a pulverized coal burning job this ship burned 449 pounds of coal per mile with a speed of 9.58 knots and 2,250 I. H. P. The coal cost $3.81 per ton trimmed in the bunker; the cost per mile was therefore $.763. To accomplish 9.58 knots as a hand-fired job would require 583 pounds per mile with $4.80 coal and the cost per mile would be $1.249. The actual saving in cost per fuel mile is shown to be 38.9 percent when the ship does a like amount of work burning pulverized coal as compared to a hand-fired job."

A report by the Government on the trial run will be issued in the near future.

New Export Coal Company Leases Kanawha Coal Land

The New Export Coal Company, of Charleston, West Virginia, operated and controlled by the M. A. Hanna Company, of Cleveland, has concluded a lease with the Blue Creek Coal & Land Company, of Charleston, W. Va., and Scranton, Pa., for an additional 2,000 acres of coal land on Campbell's Creek, Kanawha County, W. Va. This new territory has increased the holdings leased to the New Export Coal Company to approximately 5,000 acres.

The lease was negotiated through R. L. Ireland, General Manager of Bituminous Mines of the M. A. Hanna Company; A. J. Belcher, president, the New Export Coal Company; and Edward S. Jones and Charles R. Lengler, president and secretary-treasurer, respectively, of the leasing company.

The New Export Company is producing from its mine approximately 1,500 tons daily, and since the recent acquisition of additional acreage, is planning to increase production.

The Blue Creek Coal & Land Company is the owner of approximately 40,000 acres of land in Kanawha and Clay Counties, West Virginia.

Opposes Increases on Lake Cargo Coal

A vigorous protest has been filed with the Interstate Commerce Commission by W. J. Rainey, Inc., as well as by the South Fayette Coal Company, against proposed increases of 8 cents on lake cargo coal, proposed by the Pennsylvania and Pittsburgh and Lake Erie, on shipments from mines west of the Monongahela River. These mines formerly enjoyed the Pittsburgh rate of $1.46 a ton but the railroads propose to increase the rates on mines west of the Monongahela to $1.54. It is contended that lake cargo coal is highly important to these mines, but that they will be unable to compete unless given the same rate as mines strictly in the Pittsburgh district and will be compelled to close down.

C. M. Lemley is Named State Geologist of West Virginia

C. M. Lemley, of Morgantown, W. Va., was chosen October 4 as State Geologist of West Virginia to succeed the late Dr. I. C. White, by the State Geological Survey Commission.

Governor Conley, together with Dr. J. R. Turner, president of West Virginia University, effected a complete reorganization of the commission, which they planned would start work where the old board left off when the late Dr. White died three years ago.

Two other appointments were made by the commission. David B. Reger, of Morgantown, who has served as acting state geologist since the death of Dr. White, was named associate geologist in charge of the state geological museum and drill-cores. Dr. F. B. Plummer, of the University of Texas, was chosen as research professor in geology and correlating subjects at West Virginia university. He will take office at the beginning of the second semester.

Closer cooperation between the geological survey and the state university was called for in a resolution adopted by the commission. The resolution provided that all geological activities within the state should be conducted jointly by the commission and the university.

Members of the commission are Governor Conley, William S. Johnson, state treasurer; Dr. John R. Turner, president of the state university and F. B. Fromme, of the University Agricultural College.

Williamson, W. Va., Operators Hold Annual Meeting

The Seventeenth Annual Meeting of the Operators' Association of Williamson Field was held October 10 at Williamson, W. Va. At the business meeting there was an interesting program, with considerable discussion relating to the trade practice movement. The meeting was presided over by L. E. Woods, president of the association. The following officers and directors were elected for the ensuing year:

L. E. Woods, president, Crystal Block Coal & Coke Co., Welch, W. Va., president; L. D. Heustis, Gen. Mgr., Portsmouth By-Product Coke Co., Portsmouth, Ohio, vice president; W. S. Leckie, General Manager, Leckie Collieries, Aflex, Ky., Treasurer; George Coffey, president, War Eagle Coal Co., War Eagle, W. Va., George Dunglinson, Jr., manager, Fuel Department, N. & W. Railway, Bluefield, W. Va., T. H. Huddy, general manager, Bailey and Sudduth Fuel Co., Huddy, Ky., W. E. Pritchard, president, William Ann Coal Co., Huntington, W. Va., W. A. Richards, president, Majestic Collieries Co., Bluefield, W. Va., E. E.

Ritter, general manager, Red Jacket Consolidated Coal & Coke Co., Red Jacket, W. Va., John L. Tierney, president, Sharon Coal & Coke Co., Sharondale, Ky., directors; and Joseph J. Ardigo, secretary.

The banquet was attended by numerous prominent figures in the industry. Among the speakers were E. C. Mahan, former president of the National Coal Association, O. W. Evans, general superintendent, Norfolk & Western Railroad mines, W. J. Jenks, vice president of the Norfolk & Western, L. E. Woods, president of the association, and Harry L. Gandy, secretary of the National Coal Association.

Prosecution Will Follow Deaths in West Virginia Coal Mines

The increasing death toll caused by falls of roof and slate in the coal mines caused R. M. Lambie, Chief of the State Department of Mines, to warn all mine operators and executives that in the future foremen and fire bosses will be prosecuted to the full extent of the law in all cases of carelessness and improper timbering.

"In order to eliminate preventable accidents and curtail suffering the mine inspectors have been instructed to recommend that 'where workmen are injured or killed by falls of slate or coal, and it can be proved that the place was not adequately timbered, the foreman and fire bosses will be held for wilful neglect of duty and prosecuted accordingly, and if found guilty their certificates will be revoked," Mr. Lambie said.

The warning by Chief Lambie followed the issuance of his September report, which showed that 44 miners were killed in and about the coal mines.

Anthracite Production Gained in September

Shipments of anthracite for the month of September, 1929, as reported to the Anthracite Bureau of Information, Philadelphia, amounted to 5,360,130 gross tons. This is an increase as compared with shipments during the corresponding month last year of 719,135 tons, and when compared with the preceding month of August this year, shows an increase of 795,704 tons.

Reports from the hard coal region to the Pennsylvania State Department of Mines indicate better working conditions than at any time during the last three years. During September, 199 of the 219 collieries operated either full or part time with the majority on a full time basis.

A gain of 2.8 percent was estimated in the bituminous field where 10,590,000 tons were mined last month. Fifty-seven percent of the 1,779 mines were said to be in operation.

Berwind-White Buys Coal Land

The Berwind-White Coal Mining Company recently purchased 18,000 acres of coal land in the Lesher property in Wyoming and McDowell Counties, W. Va., according to announcement at the company offices. The consideration was in excess of $1,000,000.

British Miners' Hours Cut

The British government has informed officials of the miners' unions that early next year there would be a uniform reduction in the hours of work from eight to seven and one-half a day without reduction of wages as the first step toward meeting their demands.

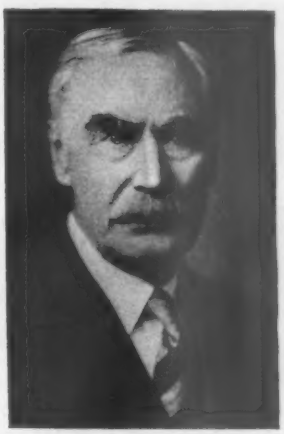
The miners sought repeal of the eight-hour act passed by the last Conservative government and reversion to the seven-hour day. The miners also demanded a national agreement and a minimum wage.

"Anthracite Trail" Named

Hoping to popularize the section of the Pennsylvania state highway from Sunbury to Reading, motorists from Northumberland and Schulkill Counties recently met at Shamokin and officially designated the route "The Anthracite Trail."

J. A. Campbell Honored On 75th Birthday

J. A. Campbell, president of the Youngstown Sheet and Tube Company, celebrated his seventy-fifth birthday anniversary on Wednesday, September 11. His admirers tendered him a dinner and a handsome testimonial at the Ohio



J. A. Campbell

Hotel in Youngstown, at which more than 300 were present, among them the leading residents of Youngstown.

In addition to this, the Youngstown Rotary Club devoted its weekly meeting to honoring Mr. Campbell, who is honorary member, and the employes at Brier Hill and Campbell Works presented him with engraved congratulations, engraved on steel. Among the telegrams was one from President Hoover.

Many prominent steel men in the country gathered at a dinner in his honor and spent the week-end at his home.

Mr. Campbell, founder and president of The Youngstown Sheet and Tube Company and one of the most widely known industrial executives of the United States, was born in Ohltown, Trumbull County, Ohio, September 11, 1854. As a boy, Mr. Campbell attended the public schools and entered Hiram College. Later he received an appointment as a cadet at West Point Military Academy and successfully passed the necessary examination, but was prevented by circumstances from embracing a military career. Instead, after leaving college, he became a clerk in a coal office at Youngstown, Ohio, in which city he has spent practically all his business life.

One of the remarkable things about his career is the fact that he did not become identified with the steel business until 1890, when he was 36 years of age. His entry into this field was as superintendent of a small iron mill not far from Youngstown. His advancement was rapid, and he soon became district superintendent of the Republic Iron and Steel Company in his home district. Resigning this position, he organized The Youngstown Sheet and Tube Company in 1900. At the beginning this company had a capital of only $600,000 and only 46 stockholders. Mr. Campbell was at first general manager of the new concern, but in 1904 was elected president, and has held this position continuously since that time. Under his management the importance of this company increased rapidly. It has now resources totalling about $300,000,000 and more than 5,000 stockholders, and is among the most successful of American Steel Companies. This company is third in the production of ingot tonnage, and few exceed it in the production of steel products. The principal products are now pipe, casing and tubing, and these materials bearing the trade name "Youngstown," are now familiar in oil fields in every part of the world. The company operated 22 tube mills and has manufacturing plants in eight states. It employes about 25,000 men, and ships its products to all parts of the United States, as well as all parts of the world. It also controls its own ores and fuels.

Mr. Campbell has been a director of the American Iron and Steel Institute for many years. During the World War he had charge of distribution of the tubular production of America on behalf of our Government and was knighted by the French and English governments for conspicuous service.

V 15 11 NOV

WITH THE MANUFACTURERS

Places New Permissible Explosive On Market

The placing on the market of a new commercial permissible explosive is announced by the Hercules Powder Company. The new explosive, Hercoal-D, is one of a series of new type explosives developed by Hercules within the past two years. The leading characteristics of Hercoal-D are: an extremely high cartridge count per 100 pounds; a minimum of smoke and fumes; a cushioned blasting effect productive of lump coal; and all the Bureau of Mines' qualifications for a permissible.

Hercial-D, with a cartridge count of approximately 450, is designed to fill the gap between Hercoal-C, with approximately 400 one and one-quarter by eight inch cartridges per 100 pounds, and Hercoal F, with approximately 500. Within a short time, the Hercoal series has assumed a leading sales position among Hercules explosives for blasting coal.

Gardner-Denver Has New Two-Stage Air Compressor

A new two stage air compressor of the vertical tandem type which is to be known as the ABA has been placed on the market by the Gardner-Denver Company. It will be manufactured in the plant at Quincy, Ill.

The new compressor is a simple, sturdy and dependable machine of high efficiency. It weighs only 350 pounds and will produce a continuous flow of 24 cu. ft. of air per minute at pressures up to 500 pounds. The low pressure head, high pressure cylinder and inter-cooler are combined in a single casting. This simplified construction reduces the number of parts to the minimum and eliminates the usual complicated system of jacket and air piping. Main bearings are of the Hyatt roller type. Lubrication is positive and automatic, being effected by a combination oil pump and splash system.

The "ABA" compressor can be furnished with pulley for "V" belt drive or for direct connection or electric motor, steam or gas engine. It is particularly suited for oil and gas engine starting and other services requiring small volumes of air at moderately high pressures.

New Dual Drive Welding Unit

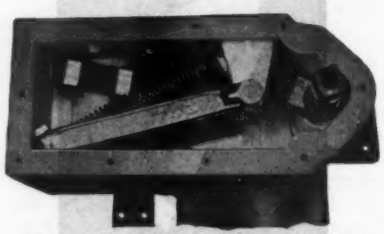
A new Dual Drive Arc Welding Unit has been introduced by the Westinghouse Electric & Manufacturing Company. This set rounds out a complete line of welding equipment.

The unit consists of a standard 300 ampere, single operator welding generator, a 15-hp., alternating current induction motor and a six cylinder, 1,800 r.p.m., Model P-45 Continental gas engine, all mounted in tandem on structural steel welded base. The motor operates on 220 volts, but by merely reconnecting the external motor leads and changing the line-starter coil, it can be used on 440 volts, thereby giving additional flexibility to the complete unit. The welding generator can be driven by either the gasoline engine or the electric motor by simply engaging or disengaging a slip coupling or clutch, whichever is provided.

The dual drive welding machines can be furnished in all the popular single operator ratings, stationary or portable.

An Electrically Operated Automatic Switch Thrower

The American Mine Door Company, of Canton, Ohio, has designed a new electrically operated automatic switch thrower which not only eliminates the dangers incident to hand-operated switches, but also speeds up haulage safely. The unit employs the solenoid principle in combination with an automatic cut-out, to actuate the mechanical connections to the track switch, whereby



The Switch Thrower With the Cover Removed

the switch points are thrown instantaneously against the rail on either side of the track.

The principle of operation is as follows: Two contactors are suspended above and clamped to the trolley wire, usually 150 ft. in advance of the switch points. Two copper plates on the under side of each contactor are electrically connected to the solenoid. One contactor throws the points for the straight track, and the other for the side track. When the locomotive passes a contactor, the trolley wheel rolls from the trolley wire onto the copper plates which causes the current to flow through the switch thrower and move the switch points to the desired position. Assuming that No. 1 contactor is nearer the switch points, a motorman traveling the straight track would pay no attention to the switch as it will always be set in this position. Choosing to run the side track, the motorman passes beneath contactor No. 2 which throws the switch for him. The power is cut off while passing contactor No. 1. The position of the contactors can be reversed if the side track is used the greater number of times.

In the switch thrower casing (shown in the illustrations) is located the cut out arm which rotates from side to side as propelled by the plunger operated by the coils of the solenoid. Contact points are located on either side of the switch thrower on the bottom of the casting. Beneath the cut out arm a connection conducts the current through the contacts to one of the coils and by so doing, actuates the coil which forces the spring arm off the contacts and to the opposite side of the casting, so that the current is broken and no danger exists to the burning out of the coil.

The electric switch thrower can be installed wherever a hand thrown switch will work, and the motorman can operate it with the locomotive controller, without moving from his seat or reducing the speed of his trip, or it may be operated by a remote control hand switch.

The American Mine Door Company will be glad to send to anyone interested a complete description of the "Electri-Throw," outlining its safety features and its ability to speed up haulage.

Hard-Boiled Hats

Bullard-Davis, Inc., is in receipt of the following information from the Department of Mines, State of Pennsylvania, relative to the use of hard boiled hats.

The State of Pennsylvania has passed an act, part of which reads:

"It shall be unlawful for any man employed as a footman at a shaft hoisting coal or other material to work at this occupation unless he has provided himself with a safety head gear or helmet of a design approved by the Department of Mines, which head gear or helmet must be worn by him at all times while on duty."

The hard boiled hat manufactured by Bullard-Davis, Inc., has been approved by the Department of Mines, State of Pennsylvania, and by the Underwriter's Laboratories for use as head protection.

A Light-weight Rock Drill for Wet or Dry Drilling

One of the latest machines in the mining field is the new model 11 rock drill, which is being produced by the Gardner-Denver Company, at its plant in Denver, Colo. This is a light all-purpose drill that can be used for wet or dry drilling. It weighs only 50 pounds and has a drilling speed equal to that of much heavier machines, the manufacturer says, and gives an unusually daily footage with a minimum of strain upon the operator, due to smoothness of operation.

This new drill may be mounted for light drifting, chanelling with a quarry bar, used on a tripod, or for miscellaneous work where a light mounted drill is desired. It takes steel ranging from ⅞ to one inch.

While in ordinary operation this drill keeps the hole clean and free from cuttings by means of sending a strong air current through the drill steel. When drilling unusually deep holes, a special blowing device can be turned on. A single oil reservoir in the cylinder lubricates all moving parts, or Gardner-Denver air line oilers also can be used on it.

New Bulletin on Mine Car Air Compressors

Chicago Pneumatic Tool Company announced Bulletin No. 750, the fourth edition, just off the press covering details of mine car air compressors.

These units are quite generally used in shipyards, quarries, large construction projects, structural yards of all kinds having a system of narrow or standard gauge tracks. They are particularly available for use along tracks at points compressed air power is wanted temporarily and where the installation of a stationary air compressor would not be warranted. These units can be furnished to run on track gauges varying from 18 in. to 56½ in.

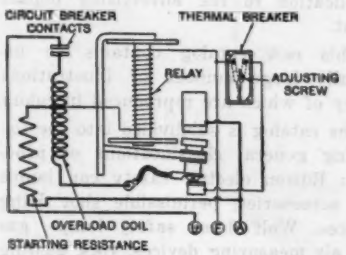
Koppers-Rheolaveur Opens Branch Office in Birmingham

The Koppers-Rheolaveur Co., Pittsburgh, designers and builders of coal washing plants, tipples and other facilities in and about mines, has opened a district office in Birmingham, Ala., at 720-21 American Traders Bank building. The office will serve Alabama, Tennessee, Western Kentucky, Indiana, and Illinois.

Koppers-Rheolaveur will be represented in Birmingham by Mr. Willard C. Adams, formerly a member of the Allen & Garcia Co. Mr. Adams opened the Birmingham office of Allen & Garcia Co. three years ago and continued as district manager. He resigned from the firm to accept this new appointment. Mr. Adams has been in mining work for more than 18 years and has been connected with the construction of many of the largest and most important mining plants in the country.

New Motor Starter With Overload Protection

The Ohio Brass Company, Mansfield, Ohio, after three years of exhaustive research, development, and severe service trials, is putting on the market a line of automatic motor starters, combining a motor starting unit with a circuit breaker for overload protection.



The New O-B Automatic Motor Starter

The cycle of operation is as follows: The circuit-breaker switch, or a line knife switch, is closed. This connects the motor to the line through the starting resistance. The operating mechanism consists essentially of a magnetic coil and armature. The coil is connected in series with the motor-shunt field, and is short-circuited by a contact made between two bi-metals. As the field current heats the bi-metal contacts, it causes the contacts to open. Thus, the operating coil is inserted in the circuit, pulls up the armature to short-circuit the starting resistance, and connects the motor to the line. Upon the completion of this starting cycle, the motor continues to run connected directly across the line.

When the motor attains full running speed, the starting resistance and bi-metal contacts of the thermal-breaker are automatically shunted out of the circuit. Resistance and thermal-breaker then cool, and are ready for the next starting operation. The time interval for starting is readily adjustable by turning the adjusting screw on the thermal element which increases or decreases the pressure on the bi-metal contacts.

Once the starter has completed the starting cycle, the complete overload coil is inserted in the circuit, and valuable and effective protection against overloads is procured.

This automatic starter is equipped with a low-voltage release which, at the failure of power, automatically releases the starter to return to the starting position; and when power returns, the starter automatically brings the motor up to full running speed and cuts it in on the line. No personal attention is required to again start the motor unless the circuit-breaker opens. When the circuit-breaker opens, it is an indication of trouble, and the operator has the opportunity to locate and correct this trouble without the danger of the motor burning before it receives attention.

They will carry out the starting cycle even though the voltage is only 1/3 of the normal value and will hold in the running position, although the line voltage drops to ¼ normal value. In other words, 250-volt starters will start on as low as 85 volts and hold in as low as 65 volts.

In the varied and often extreme conditions and fluctuations of voltage, in mine service, these features are of great value in reducing the attention required for motor starters.

O-B Automatic Motor Starters are for use with shunt and compound-wound motors. They are regularly furnished for standard motors from 2 to 15 hp. rated at 250 and 600 volts. However, starters can be furnished for use with motors under 2 hp. and over 15 hp.

Six-Cylinder Gas Engine Drives New Portable Arc Welder

A new portable electric arc welding machine announced by the General Electric Company is driven by a 6-cylinder gas engine, and replaces the 4-cylinder engine-driven unit previously included in that company's line. Advantages of the 6-cylinder engine are ease of starting, steadiness of operation and greater capacity. The generator bears the designation WD-300-A.

The new engine is the Buda model HS-6 power unit, built especially for industrial service. The cylinder head is a four-cycle, L-type. The bore is 3⅜ inches and the stroke, 4½ inches. The S. A. E. horsepower rating is 27.3 and the actual brake horsepower is 39 at 1440 r. p. m. The engine is totally enclosed in a sheet-metal housing. Gasoline consumption averages 2.4 gallons an hour for average welding duty at full normal-rated load.

The set is approximately 88 inches long, 32 inches wide and 96 inches high, the last dimension including 18 inches for the running gear.

New M-S-A General Catalog

The Mine Safety Appliances Company, Braddock, Thomas and Meade Streets, Pittsburgh, Pa., has just issued their new No. 4 General Catalog of 160 pages covering "Everything for Mine and Industrial Safety." Copies will be furnished gratis to all those interested in the safety and welfare of employes, upon application to the advertising department.

This new catalog contains an unusually large number of illustrations, many of which are reproduced in colors.

The catalog is subdivided into the following general classifications of products: Edison electric safety cap lamps and accessories, permissible shot firing devices, Wolf flame safety lamps, gas and air measuring devices, rock dusting equipment, oxygen breathing apparatus, a complete line of gas mask respiratory protective equipment, gas detectors and recorders, resuscitation equipment, eye and head protective equipment, safety clothing, safety saws and a complete line of first aid supplies. Unusual features include the "Lung," a practical submarine self-rescue device and an improved gas mask face piece developed in the M-S-A experimental laboratories.

The Mine Safety Appliances Company is the largest manufacturer of safety equipment in the world and has nearly 50 representatives of its own stationed in mining and industrial centers from coast to coast as well as in Canada and Mexico.

New Hercules Powder Publication

A recent publication issued by the Hercules Powder Company is called "The Labors of a Modern Hercules." The brochure consists of a series of articles by chemists, engineers, and officers of the Hercules company descriptive of Hercules processes and products and the ways in which industry is served by them.

The articles tell of the achievements of chemical research, of the chemist's contribution to beauty and utility, and the scope of operations in which explosives, naval stores, nitrocellulose, purified cotton linters, and acids plays a part. Descriptions of the manufacture of black blasting powder, smokeless shot-gun and rifle powders, dynamites, gelatin, and blasting and electric blasting caps are included.

The part which the research laboratories take in the development of new products and processes forms an interesting chapter. "The Labors of a Modern Hercules" may be obtained by writing to the Hercules Powder Company, Wilmington, Delaware.

Oxwelding Design Standards

The Linde Air Products Company has published a booklet entitled "Design Standards for Oxwelded Steel and Wrought Iron Piping." It is intended to enable the engineer and architect to design gas welded steel or wrought iron piping systems, for any purpose, according to the best practice yet developed, and covers all of the necessary structural details.

This booklet has been published to meet a definite demand created by the extensive application of the welding process to modern piping services, and should prove of interest to designing engineers and architects. It is available through district offices of the Linde Air Products Company.

Westinghouse-Nuttall Pamphlet On Bedplates

Bedplates for Types SVR and DVR Speed Reducers is the subject of a new publication, Circular 1856, issued by the Westinghouse Electric and Manufacturing Company. Information pertaining to construction, dimensions and weights, and motor sizes for bedplates with and without outboard bearing pedestals, is given in tabulated form, accompanied by outline drawings and illustrations.

Copies may be obtained from any Westinghouse sales office or from the Advertising Department of the Westinghouse Electric & Manufacturing Company at East Pittsburgh, Pa.

Redesigned Motor Starters Have New Meters and Relays

The new rectangular type of meter with non-glare glass and a new type of field actuating relay are incorporated in the synchronous motor starters, which have just been redesigned by the General Electric Company. CR-1135 is the designation of a line of semi-magnetic, reduced-voltage starters for synchronous motors. Designation CR-7061 covers magnetic reduced voltage starters and designation CR-7065 is assigned to a line of magnetic full-voltage starters for synchronous motors, all having been revised to incorporate the new devices.

The operation of the new field actuating relay, which controls the field contactor, is dependent upon the speed of the motor and, in addition, a definite time delay after the motor reaches approximately 95 percent speed. When full voltage is applied to the motor the immediate closing of the relay contacts is prevented by a lock-out coil in parallel with the discharge resistor and energized by the voltage across this resistor.

New Prest-O-Lite Acetylene Gas Plant Opened at Grand Rapids, Mich.

A new Prest-O-Lite acetylene gas plant, located at 575 Kirkland Street, Grand Rapids, Mich., has just been placed in operation by the Prest-O-Lite Company, Inc. of New York City.

This latest addition to the growing chain of Prest-O-Lite acetylene gas plants is under the superintendency of George Rose, Jr.

The Ford Motor Company of Dearborn, Mich., have ordered one 600-hp. and one 300-hp. oil-electric locomotives from the Ingersoll-Rand Company for the Rouge River plant. These locomotives will be furnished with General Electric equipment and will be built at their Erie Works.

Combustion Engineering Corporation, New York, N. Y., has just issued a 16-page catalog illustrating and briefly describing the more important fuel-burning and steam-generating equipment manufactured by Combustion Engineering Corporation, N. Y. A complete list of C-E Products is shown.

The Roller-Smith Company, 233 Broadway, New York City, announces a new issue of its Bulletin No. 810, covering its types TW, FW and STW thermocouple ammeters and milli-ammeters for direct current and alternating current of all frequencies, including radio frequencies.

AMERICAN
LEAD
ZINC

HEART OF THE
TRI-STATE DISTRICT

Greatest Zinc Mining Field
In The World

TRI-STATE ZINC & LEAD ORE PRODUCERS ASSOCIATION

MISSOURI
KANSAS
OKLAHOMA

Offices at Picher, Oklahoma

DON'T LET IT RUST; ZINC IT

AERIAL PHOTO BY
GREGORY & WINGO
JOPLIN, MO.

EAGLE

Solders are liked for their *dependability*

Because of their uniform purity—and accuracy in meeting exact needs—Eagle Solders are cutting costs and increasing production in large and small shops everywhere.

Experienced users of solder—who have learned the importance of scientific accuracy and uniform quality—use Eagle Solders for their great *dependability.*

The Eagle-Picher Lead Company, Chicago, Joplin, Cincinnati.

Reg. U. S. Pat. Off.

EAGLE Lead Pipe · Fittings · Solder

COMMERCE MINING AND ROYALTY COMPANY

PRODUCERS OF ZINC AND LEAD ORES

MINES LOCATED IN OKLAHOMA AND KANSAS

MAIN OFFICE, MIAMI, OKLA.

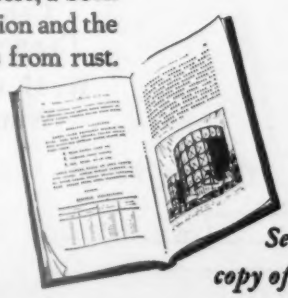
EAGLE *Sublimed* BLUE LEAD

"Does not harden in the container"

"Fighting RUST with Sublimed Blue Lead"

Here is a book written for engineers by engineers, a book which outlines concisely the problem of corrosion and the development of a paint to protect metal surfaces from rust.

"Fighting Rust with Sublimed Blue Lead" presents scientific data on the uses and application of this rust-inhibitive paint pigment. Engineers have found this book unusually informative. Send for your free copy today. *The Eagle-Picher Lead Company, 134 North La Salle Street, Chicago.*



Send for your **FREE** *copy of this valuable book*

CANAM METALS CORPORATION

CANAM-MEX MINES CORPORATION

Producers of LEAD and ZINC Concentrates

Clement K. Quinn, President
Duluth, Minnesota

R. S. Archibald, Vice-President
Negaunee, Michigan

MEXICO

Zacatecas Metals, S. A.

J. C. Archibald, Manager
El Paso, Texas

TRI-STATE DISTRICT

Canam Metals Corporation
Canam-Mex Mines Corporation

C. W. Nicolson, Manager
Joplin, Missouri

CANADA

Canam Metals, Ltd.
Canam-Mex Mines, Ltd.
W. H. Crago, Cons. Engr.
Winnipeg, Manitoba

Nationally Known Products Made by the Pioneer Manufacturer of ZINC PRODUCTS

Zinc Oxide

"Albalith" Lithopone

Cryptone (high zinc sulphide lithopone)

Zinc Sulphide

Horse Head Slab Zinc (Spelter)

Bertha Slab Zinc

Mossey Zinc

Feathered Zinc

Zamak

(The (4-3-.1) Zinc Base Die Casting Alloy)

Rolled Zinc Sheets and Strips

Zinc Plates

Sulphuric Acid

Spiegeleisen

New Jersey Zinc

The

New Jersey Zinc Co.

(of Pa.)

160 Front Street, New York City

INTERSTATE ZINC & LEAD COMPANY

Head Office
25 BROAD STREET
NEW YORK

R. M. ATWATER, Jr.
President

C. F. DIKE
Vice President—General Manager

L. E. WHICHER
Treasurer

S. L. SHERMAN
Secretary

MINES AT

Cardin, Okla. Treece, Kans. Baxter, Springs, Kans.

DO IT BY OXWELDING

AS pioneers in every phase of oxy-acetylene welding and cutting, the thoroughly experienced engineering and service organizations of these companies can help you in the proper application of oxwelding to your present work and to new production activities.

Fulfilling every need for Oxwelding and Cutting.....

LINDE OXYGEN
The Linde Air Products Company

Prest-O-Lite
Dissolved Acetylene
The Prest-O-Lite Company, Inc.

Oxweld
Apparatus and Supplies
Oxweld Acetylene Company

UNION CARBIDE
Union Carbide Sales Company

Units of
UNION CARBIDE AND CARBON CORPORATION

General offices
30 East 42nd Street
New York, N. Y.

UCC

Sales offices in
Principal cities
throughout the country

64 Linde plants—45 Prest-O-Lite plants—154 Oxygen Warehouse stocks—138 Acetylene Warehouse stocks—38 Apparatus Warehouse stocks—235 Carbide Warehouse stocks

You can't do this with any other cable!

Reports from hundreds of users, accompanied with repeat orders, is evidence that *preforming* is the first step in many years to lower rope expense. This is backed up by eight years of approval by all branches of industry. These are the reasons:

1. Longer life due to less fatiguing action.
2. Tru-Lay resists unstranding. It can be cut without seizing. Broken wires lie flat, eliminating wear on adjacent wires and wear on sheave and drum grooves.
3. Tru-Lay resists kinking. It is easier to handle.
4. Each strand carries its share of the load. Therefore, there is no high or low stranding.
5. Tru-Lay is easily spliced. Individual strands keep their helical shape and are easily fitted into a splice.
6. Greater safety—because of less internal torsional stress—premature failure and premature broken wires are eliminated in Tru-Lay Preformed Wire Rope.

Actual photo of unseized end

This is a photo of a piece of Tru-Lay Preformed Wire Rope, just as it comes from the warehouse. Note how each wire and strand lies in position—proof that there is no pent-up stress in wires and strands.

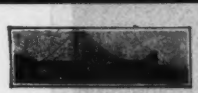
AMERICAN CABLE COMPANY, *Inc.*
New York Central Bldg., 230 Park Ave., New York, N. Y.

District Offices:
Chicago, Detroit, Philadelphia, Pittsburgh, Tulsa, San Francisco
An Associate Company of the American Chain Company, *Incorporated*
Canadian Licensed Manufacturers
Dominion Wire Rope Company, *Limited*, Montreal
Canada Wire & Cable Co., *Limited*, Toronto

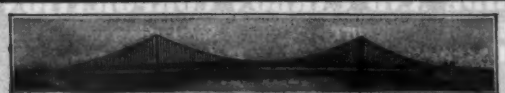
PREFORMED WIRE ROPE

TRADE **TRU-LAY** MARK

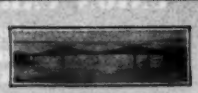
(Reg. U. S. Pat. Off.)



Detroit International Bridge



Philadelphia-Camden Bridge
The World's Greatest Suspension Bridge



Mt. Hope Bridge
Bristol, R. I.

Jump-over Turnout
installed *without cutting* main rails

Bethlehem Jump-over Turnouts are furnished complete with five special steel ties, two special switch points, jump-over frog, guard rail and right angle switch stand.

Bethlehem Jump-over Frog

Loading operations in rooms where mechanical loaders are used very often require double track to supply cars to the loader so that its efficiency can be maintained.

The Bethlehem Jump-over Turnout provides a means of easily advancing a short section of double track close to the working face without breaking the main line, thus eliminating the laying of double track from the entry. This turnout is so constructed that it may be used with track that is laid with either steel or wood ties.

The specially made ties have steel riser blocks fastened to them upon which the curved closure rails are securely held by heavy clips, and which raise the rails gradually to enable the flanges of the car wheel to ride over the main rail at the frog. The special switch point, which is longer than the ordinary type, rests upon the top of the main rail and inclines gradually, so that the wheel flange will ride over the top of the rail. This turnout is equipped with a right-angle throw stand; a parallel-throw stand will be supplied at a small additional cost.

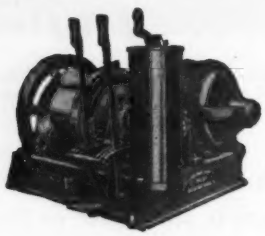
BETHLEHEM STEEL COMPANY

General Offices: BETHLEHEM, PA.
District Offices: New York, Boston, Philadelphia, Baltimore, Washington, Atlanta, Pittsburgh, Buffalo, Cleveland, Detroit, Cincinnati, Chicago, St. Louis, San Francisco, Los Angeles, Seattle, Portland, Honolulu

BETHLEHEM
JUMP-OVER TURNOUT

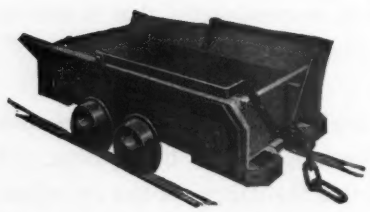
"UNITED"
OFFERS
A COMPLETE LINE of COAL MINING AND PREPARATION EQUIPMENT

CATALOG ON REQUEST

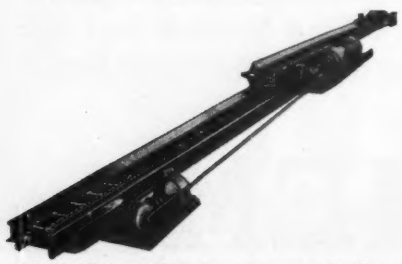


HOISTS

There is a type hoist manufactured by "United" for every coal mining need.



"United" was a pioneer builder of coal cars using "Timken" Roller Bearings—that effect great economy. All types for every mining need available.



"United" Long-Wall Face Conveyor handles large lumps of coal. Suitable for use with slack or lumps, either wet or dry. Circular on request.

Prompt Shipments Reasonably Priced

Mine and Rock Cars; Mine Car Trucks of all kinds; Tipple Equipment including Cages, Dumps, Screens, Feeders, Crushers, Conveyors, Loading Booms, Chutes, Doors, Weighing Pans and Scales, Picking Tables; Hoists, Steam Geared or First Motion, Electric or Belted; Cast Iron or Steel Spoked Sheave Wheels; Drill Rigs; Centrifugal Pumps; Ventilating Fans—in fact, everything needed for the original installation to the maintenance of the existing equipment can be furnished by "United."

We Solicit Your Inquiries

"United" earnestly solicits your inquiries for equipment needed in coal mining, conveying or preparation. Complete information with prices will be furnished promptly. The long period of years engaged in coal mining and preparation equipment manufacture indicates the quality of "United" Products—and bespeaks the satisfied service you will receive therefrom. Send us your inquiries NOW.

Catalog Available

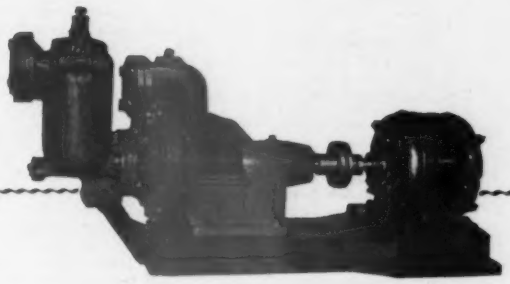
UNITED IRON WORKS, INC.

512 RIDGE ARCADE BLDG., KANSAS CITY, MO.

Manufacturers of a complete line of Coal Mining and Preparation Equipment

"UNITED" IRON WORKS INC.
FOR SERVICE

"Standard for Dependable Service"



Special features of design and construction that eliminate costly maintenance items and insure reliable performance under varying service conditions have made LaBour Self-Priming Centrifugal Pumps standard drainage equipment in mines throughout the country. Rugged, simple and compact, they are built to withstand severe service of long duration, and require a minimum of attention during operation. The patented impeller is THE ONLY MOVING PART. No check valves or priming chambers are required. LaBour Pumps actually PUMP AIR AND PRIME THEMSELVES. Wide clearances and special construction alloys allow for the handling of dirty and corrosive water without impairing pumping efficiency, while large capacity enables LaBour Pumps to meet with emergency as well as all ordinary water conditions.

The LaBour Gathering Valve

The LaBour Gathering Valve provides automatic sealing of the suction line when the water is low, and thus enables the pump to gather from several sumps simultaneously even though located on different levels. Compact, rugged, and made of non-corrosive materials.

WRITE FOR BULLETIN

THE LABOUR CO., INC.
ELKHART, INDIANA

LA BOUR PUMPS

NEVER LAY DOWN ON THE JOB

BUYER'S DIRECTORY

ACETYLENE, Dissolved (Or in Cylinders)
Prest-O-Lite Co., Inc.

ACETYLENE GAS
Prest-O-Lite Co., Inc.

ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co.

ACID, SULPHURIC
Irvington Smelt. & Ref. Works.

AERIAL TRAMWAYS
American Steel & Wire Co.

AFTERCOOLERS (Air)
Ingersoll-Rand Co.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co.
Sullivan Machinery Co.
Ingersoll-Rand Co.

AIR COMPRESSOR OILS
Standard Oil Co. (Ind.)

AIR FILTERS—Bag type
American Coal Cleaning Corpn.

AIR HEATERS
Westinghouse Electric & Mfg. Co.

AIR LIFT PUMPING
Sullivan Machinery Co.

ALL SERVICE GAS MASKS
Mine Safety Appliances Co.

ANEMOMETERS
Mine Safety Appliances Co.

ANNUNCIATOR WIRES & CABLES
Roebling's Sons Co., J. A.

ANNUNCIATOR WIRES & CABLES, INSULATED
American Steel & Wire Co.

ANTI-RUST OILS & GREASES
Standard Oil Co. (Ind.)

ARMATURE COILS & LEADS
General Electric Co.
Roebling's Sons Co., J. A.
Westinghouse Electric & Mfg. Co.

ARMORGRIDS
General Electric Co.

ASPIRATORS
American Coal Cleaning Corpn.

AUTOMATIC CAR & CAGER STOPS
Link-Belt Co.
Mining Safety Device Co.

AUTOMATIC CAR CAGES
Connellsville Mfg. & Mine Supply Co.
Link-Belt Co.
Roberts & Schaefer Co.

AUTOMATIC CAR DUMPERS
Link-Belt Co.
Roberts & Schaefer Co.

AUTOMATIC FLAGGING SIGNALS
American Mine Door Co.

AUTOMATIC (Mine Doors, Trucks and Electric Switches)
American Mine Door Co.

AUTOMATIC MINE SWITCHES
Westinghouse Electric & Mfg. Co.

AUTOMATIC SWITCH THROWERS
American Mine Door Co.
Westinghouse Electric & Mfg. Co.

AUTOMOBILE CABLES
Roebling's Sons Co., J. A.

AUTOMOTIVE LUBRICANTS
Keystone Lubricating Co.

BAG TYPE AIR FILTERS
American Coal Cleaning Corpn.

BALLAST UNLOADER ROPES
Roebling's Sons Co., J. A.

BARS, STEEL
Carnegie Steel Co.
Timken Roller Bearing Co.

BATTERIES
E. I. du Pont de Nemours & Co.

BATTERIES, Armature
Westinghouse Electric & Mfg. Co.

BATTERIES, Blasting
Hercules Powder Co.

BATTERIES, DRY (for Bells, Buzzers, Signals, Blasting)
National Carbon Co., Inc.

BATTERIES (Storage, Gas Welding, Cutting, Dissolved Acetylene)
Prest-O-Lite Co.
Westinghouse Electric & Mfg. Co.

BATTERY CHANGING STATION
Atlas Car & Mfg. Co.

BEARINGS (for all kinds of equipment)
Hyatt Roller Bearing Co.

BEARINGS, RADIAL
Timken Roller Bearing Co.

BEARINGS, TAPERED ROLLER
Timken Roller Bearing Co.

BEARINGS, THRUST
Timken Roller Bearing Co.

BELL CORD
Roebling's Sons Co., J. A.

BELT DRESSING
Standard Oil Co. (Ind.)

BELTING (Conveyor, Elevator, Transmission)
The Jeffrey Mfg. Co.
Link-Belt Co.

BELTING, SILENT CHAIN
Link-Belt Co.
Morse Chain Co.

BINS (Coke and Coal)
The Jeffrey Mfg. Co.
Link-Belt Co.

BIT BOXES
Mine Safety Appliances Co.

BITS, Carbon (Diamonds) for Core Drill
R. S. Patrick.
Diamond Drill Carbon Co.

BITS, Diamond Drilling
R. S. Patrick.

BIT SHARPENERS
Sullivan Machinery Co.
Ingersoll-Rand Co.

BLACK DIAMONDS
Diamond Drill Carbon Co.
R. S. Patrick.

BLACK OILS
Standard Oil Co. (Ind.)

BLASTING ACCESSORIES
E. I. du Pont de Nemours & Co.

BLASTING CAPS
E. I. du Pont de Nemours & Co.
Hercules Powder Co.

BLASTING MACHINES
E. I. du Pont de Nemours & Co.
Hercules Powder Co.

BLASTING POWDER
E. I. du Pont de Nemours & Co.
Hercules Powder Co.

BLASTING SUPPLIES
Hercules Powder Co.

BLASTING UNITS (Dry Battery)
National Carbon Co., Inc.

BLOWERS, CENTRIFUGAL
American Coal Cleaning Corpn.
General Electric Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

BLOWERS (or Compressors)
General Electric Co.

BLOWERS (Tubing)
The Jeffrey Mfg. Co.
Robinson Ventilating Co.

BLOWERS (Turbine)
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

BLOWPIPES, Brazing, Carbon Burning, Cutting, Lead Burning Welding, Welding and Cutting
Oxweld Acetylene Co.

BLUE CENTER STEEL WIRE ROPE
Roebling's Sons Co., J. A.

BOND TERMINALS
American Mine Door Co.

BORTZ
R. S. Patrick.
Diamond Drill Carbon Co.

BRACES, GAUGE
Central Frog & Switch Co.

BRACES, RAIL
Central Frog & Switch Co.

BRACES, TRACK
Central Frog & Switch Co.

BRAZILIAN ROCK CRYSTAL
Diamond Drill Carbon Co.

BREAKER MACHINERY
Koppers-Rheolaveur Co.
Vulcan Iron Works.

BREAKERS
American Coal Cleaning Corpn.

BREAKERS (Construction and Machinery)
The Jeffrey Mfg. Co.

BREAST MACHINES
Goodman Mfg. Co.

BRIQUETTING MACHINERY
Vulcan Iron Works.

BRUSHES (Carbon, Graphite and Metal Graphite for Electric Motors, Generators and Converters)
National Carbon Co., Inc.
Westinghouse Electric & Mfg. Co.

BUCKETS (Elevator)
Atlas Car & Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

BURRELL, GAS INDICATORS, GAS MASKS, MINE AIR ANALYZER
Mine Safety Appliances Co.

CABLE COMPOUNDS
Standard Oil Co. (Ind.)

CABLE—DRILLING, WIRE
American Cable Co.

CABLE—ELEVATOR, MACHINE, ETC. (STEEL)
American Cable Co.

CABLE GREASE
Keystone Lubricating Co.

CABLE—HOISTING
American Cable Co.

CABLE — MINING (HAULAGE, SHAFT HOIST, MINING MACHINE, SLUSHER)
American Cable Co.

CABLES
American Steel & Wire Co.
Roebling's Sons Co., J. A.

CABLES (Connectors and Guides)
American Mine Door Co.

CABLES, INSULATED
General Electric Co.
Roebling's Sons Co., J. A.

CABLES, SUSPENSION BRIDGE
American Cable Co.
Roebling's Sons Co., J. A.

CABLEWAYS
American Steel & Wire Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

CABLE—WIRE
American Cable Co.

CAGE DUMPERS, ROTARY
Link-Belt Co.
Roberts & Schaefer Co.

CAGES (Safety Appliances)
Connellsville Mfg. & Mine Supply Co.

CAGE STOPS & LOCKS
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

CAGERS, AUTOMATIC
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

CAGERS, AUTOMATIC & MANUAL
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

CAGES
Allis-Chalmers Mfg. Co.
C. S. Card Iron Works Co.
Connellsville Mfg. & Mine Sup. Co.
Link-Belt Co.
United Iron Works, Inc.
Vulcan Iron Works.

CAGES (Self-dumping)
Link-Belt Co.
Roberts & Schaefer Co.
Vulcan Iron Works.

CALCINERS
Vulcan Iron Works.

CALCIUM CARBIDE
Union Carbide Sales Co.

CARBON AND BORTZ
Diamond Drill Carbon Co.
R. S. Patrick.

CARBON FOR DIAMOND DRILLING
Diamond Drill Carbon Co.
R. S. Patrick.
Sullivan Machinery Co.

CARBON BURNING APPARATUS
Oxweld Acetylene Co.

CARBON ELECTRODES (for Electric Furnaces and Electrolytic Work)
National Carbon Co., Inc.
Westinghouse Electric & Mfg. Co.

CARBON MONOXIDE DETECTOR
Mine Safety Appliances Co.

CARBONS (for Arc Lamps, Blue Printing, Photographic)
National Carbon Co., Inc.

CARBON RODS AND PASTE FOR WELDING
Oxweld Acetylene Co.
National Carbon Co., Inc.

CARBON SPECIALTIES (Circuit Breaker Contacts, Packing Rings, Filter Plates, Tubes, etc.)
National Carbon Co., Inc.

CAR DUMPERS, GRAVITY & POWER
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

CAR DUMPERS (Rotary)
Connellsville Mfg. & Mine Supply Co.
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

CAR FEEDERS
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

CAR HAULS
Goodman Mfg. Co.
Hockensmith Wheel & Mine Car Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

CAR PULLERS
Allis-Chalmers Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

CAR REPLACERS
Johnson Wrecking Frog Co.

CAR RERAILERS
Johnson Wrecking Frog Co.

CAR RETARDERS
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

CARS OF ALL DESCRIPTION
Hockensmith Wheel & Mine Car Co

CAR STOPS, AUTOMATIC & MANUAL
Link-Belt Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

CAR WHEEL LUBRICANTS
Keystone Lubricating Co.

CAR WIRE & CABLES
American Steel & Wire Co.
John A. Roebling's Sons Co.

CASTINGS
Goodman Mfg. Co.
Link-Belt Co.
The Jeffrey Mfg. Co.
Timken Roller Bearing Co.

CASTINGS, GRAY IRON
Link-Belt Co.
Vulcan Iron Works.

CASTINGS, OPEN HEARTH, STEEL
Vulcan Iron Works.

CASTINGS (Steel, Iron)
Vulcan Iron Works.

CAST STEEL FROGS
Central Frog & Switch Co

From Start To Finish With Carbic Light

Wherever building and construction work is carried on, emergencies are bound to arise. Breakdowns, adverse weather conditions and unexpected holdups tend to make the job lag behind. Such delays, however, may often be economically overcome by a regular night shift.

Successful contractors throughout the country provide Carbic Flood Lights for their jobs from start to finish and keep up to schedule. Contracts completed on time give them added profits—and reputation.

Carbic Flood Lights are simple, rugged and portable. They are always ready for service. Carbic Light costs only a few cents an hour and under its clear white rays your men can work with daylight rapidity and safety.

Complete the Job on Time with Carbic Light

OXWELD ACETYLENE COMPANY

Unit of Union Carbide and Carbon Corporation

NEW YORK CITY
Carbide and Carbon Building

UCC

CHICAGO
Carbide and Carbon Building

SAN FRANCISCO
Adam Grant Building

Carbic is distributed by the Union Carbide Sales Company through its national chain of warehouses and is sold by jobbers everywhere.

Technical Publicity Department, Oxweld Acetylene Company
205 East 42nd Street, New York, N. Y.

Without obligation, I would like to have additional information on Carbic Lights.

Name.....

Street Address.....

City..... *State*.....

CHAINS
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co.
Morse Chain Co.

CHAINS, COAL CUTTING
Goodman Mfg. Co.
The Jeffrey Mfg. Co.

CHAINS, DRIVE
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.

CHAINS, FRONT END
Link-Belt Co.
Morse Chain Co.

CHAIN LUBRICANTS
Standard Oil Co. (Ind.)

CHAINS, OILING
Morse Chain Co.

CHAINS, POWER TRANSMISSION
The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.

CHAINS, Silent (Bushed-Pin Joint)
Link-Belt Co.

CHAINS, SILENT (Rocker-Joint)
Morse Chain Co.

CHAINS, SLING
Link-Belt Co.
Morse Chain Co.

CHAINS, SPROCKET WHEEL
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.

CIRCUIT-BREAKERS
Westinghouse Electric & Mfg. Co.

CLAMPS, GUARD RAIL
Central Frog & Switch Co.

CLAMPS (Mine)
Westinghouse Electric & Mfg. Co.

CLAMPS (Trolley)
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

CLAMPS, WIRE ROPE
American Steel & Wire Co.
Roebling's Sons Co., J. A.

CLIPS, WIRE ROPE
American Cable Co.
American Steel & Wire Co.
Roebling's Sons Co., J. A.

CLOTH, WIRE
Ludlow Saylor Wire Co.

CLUTCHES
Connellsville Mfg. & Mine Supply Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

COAL CLEANING MACHINERY
American Coal Cleaning Corpn.
Koppers-Rheolaveur Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

COAL COMPANIES
Lehigh Coal & Navigation Co.

COAL CONVEYING MACHINERY
American Coal Cleaning Corpn.
Conveyor Sales Co.
Link-Belt Co.

COAL CRUSHERS
Connellsville Mfg. & Mine Supply Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

COAL CRUSHERS & ROLLS
The Jeffrey Mfg. Co.
Link-Belt Co.
Vulcan Iron Works.

COAL CUTTERS
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Sullivan Machinery Co.

COAL HANDLING MACHINERY
American Coal Cleaning Corpn.
Conveyor Sales Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Joy Manufacturing Co.
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.
Westinghouse Electric & Mfg. Co.

COAL LOADERS
Conveyor Sales Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Joy Manufacturing Co.
Link-Belt Co.
Sullivan Machinery Co.

COAL MINING MACHINERY
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Sullivan Machinery Co.
Westinghouse Electric & Mfg. Co.

COAL MINING PLANTS
American Coal Cleaning Corpn.
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

COAL PREPARATION MACHINERY
American Coal Cleaning Corpn.
Link-Belt Co.
Roberts & Schaefer Co.

COAL SEPARATING MACHINERY
W. S. Tyler Co.

COAL SEPARATORS (Pneumatic)
American Coal Cleaning Corpn.
Roberts & Schaefer Co.

COAL SEPARATORS (Spirallizers)
Link-Belt Co.

COAL TESTING EQUIPMENT
W. S. Tyler Co.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

COMPRESSORS, MINE CAR
Ingersoll-Rand Co.
Sullivan Machinery Co.

CONCENTRATORS (Table)
Allis-Chalmers Mfg. Co.

CONCRETE REINFORCEMENT
American Steel & Wire Co.

CONDENSERS
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
Westinghouse Electric & Mfg. Co.

CONTROLLERS
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.

CONVERTERS, COPPER
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.

CONVEYORS
American Coal Cleaning Corpn.
Conveyor Sales Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.
United Iron Works, Inc.

CONVEYOR BEARINGS
Link-Belt Co.

CONVEYORS, BELT
American Coal Cleaning Corpn.
The Jeffrey Mfg. Co.
Link-Belt Co.

CONVEYORS, CHAIN FLIGHT
American Coal Cleaning Corpn.
The Jeffrey Mfg. Co.
Link-Belt Co.

CONVEYORS, COAL
American Coal Cleaning Corpn.
Conveyor Sales Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Vulcan Iron Works.

CONVEYORS AND ELEVATORS
Allis-Chalmers Mfg. Co.
American Coal Cleaning Corpn.
The Jeffrey Mfg. Co.
Link-Belt Co.

CONVEYORS, PAN OR APRON
American Coal Cleaning Corpn.
The Jeffrey Mfg. Co.
Link-Belt Co.

CONVEYORS, SCREW
American Coal Cleaning Corpn.
The Jeffrey Mfg. Co.
Link-Belt Co.

COOLERS (Man)
Robinson Ventilating Co.

COOLERS, ROTARY
Vulcan Iron Works.

COPPER WIRE & STRAND (Bare)
American Steel & Wire Co.
Roebling's Sons Co., J. A.

CORDS—SASH, STEEL WIRE
American Cable Co.

CORE DRILLS, Carbon (Diamonds) for
R. S. Patrick.

CORE DRILLING
Hoffman Bros. Drilling Co.
Pennsylvania Drilling Co.

COUPLINGS, FLEXIBLE
Link-Belt Co.
Westinghouse Electric & Mfg. Co.

CREOSOTE TREATED TIES, TIMBERS, POSTS, PILING, Etc.
Ayer & Lord Tie Co.

CROSSINGS AND CROSSOVERS
C. S. Card Iron Works Co.
Central Frog & Switch Co.
West Virginia Rail Co.

CROSSOVERS
Central Frog & Switch Co.

CROSS TIES, CREOSOTE TREATED
Ayer & Lord Tie Co.

CRUSHER OILS
Standard Oil Co. (Ind.)

CRUSHERS
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
United Iron Works, Inc.

CRUSHERS (Coal)
Connellsville Mfg. & Mine Supply Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Vulcan Iron Works.

CRUSHERS, SINGLE and DOUBLE ROLL
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

CRUSHING PLANTS, COKE
The Jeffrey Mfg. Co.
Link-Belt Co.

CRYSTAL (Quartz)
Diamond Drill Carbon Co.

CUP GREASE
Keystone Lubricating Co.
Standard Oil Co. (Ind.)

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co.

CYCLONE DUST COLLECTORS
American Coal Cleaning Corpn.

DECARBONIZING APPARATUS
Oxweld Acetylene Co.

DESIGNERS OF PLANTS
American Coal Cleaning Corpn.
Koppers-Rheolaveur Co.
Link-Belt Co.
Roberts & Schaefer Co.

DETONATORS
E. I. du Pont de Nemours & Co.
Hercules Powder Co.

DIAMOND CORE DRILL CONTRACTING
Hoffman Bros. Drilling Co.
Sullivan Machinery Co.

DIAMOND DRILLING CARBON
Diamond Drill Carbon Co.
R. S. Patrick.

DIAMONDS, BLACK (See Carbon and Bortz)
Diamond Drill Carbon Co.
R. S. Patrick.

DIAMONDS, INDUSTRIAL
Diamond Drill Carbon Co.
R. S. Patrick.

DIAMOND TOOLS
Diamond Drill Carbon Co.

DIESEL ENGINE OILS
Standard Oil Co. (Ind.)

DIGGERS & PICKS (Pneumatic)
Ingersoll-Rand Co.

DOORS, AUTOMATIC MINE
American Mine Door Co.

DRIFTERS, DRILL
Ingersoll-Rand Co.
Sullivan Machinery Co.

DRILLERS' DIAMONDS
Diamond Drill Carbon Co.

DRILLING CONTRACTORS
Pennsylvania Drilling Co.
Sullivan Machinery Co.

DRILLING, DIAMONDS for
Diamond Drill Carbon Co.
R. S. Patrick.

DRILLS, AIR AND STEAM
Ingersoll-Rand Co.

DRILLS (Blast Hole)
Ingersoll-Rand Co.

DRILL BITS, Carbon (Diamonds) for
Diamond Drill Carbon Co.
R. S. Patrick.

DRILL, CARBON (Diamonds) for
Diamond Drill Carbon Co.
R. S. Patrick.

DRILL COLUMNS & MOUNTINGS
Ingersoll-Rand Co.
Sullivan Machinery Co.

DRILL LUBRICANTS
Standard Oil Co. (Ind.)

DRILLER'S DIAMONDS
R. S. Patrick.

DRILLS, CORE
Hoffman Bros. Drilling Co.
Ingersoll-Rand Co.

DRILLS, ELECTRIC
General Elcetric Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.

DRILLS, HAMMER
Ingersoll-Rand Co.
Sullivan Machinery Co.

DRILLS (Hand Operated Coal)
Ohio Brass Co.

DRILLS, PNEUMATIC
Ingersoll-Rand Co.

DRILLS, PROSPECTING
Hoffman Bros. Drilling Co.
Ingersoll-Rand Co.

DRILLS, ROCK
General Electric Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Sullivan Machinery Co.

DRILL STEEL SHARPENERS
Ingersoll-Rand Co.
Sullivan Machinery Co.

DRIVES, SILENT CHAIN
Link-Belt Co.
Morse Chain Co.

DRUMS (Hoisting, Haulage)
Connellsville Mfg. & Mine Supply Co.
Link-Belt Co.
Vulcan Iron Works.

DRY CLEANING COAL & COKE
American Coal Cleaning Corpn.
Link-Belt Co.
Roberts & Schaefer Co.

DRYERS, ROTARY
Vulcan Iron Works.

DUMP CARS
Atlas Car & Mfg. Co.
Connellsville Mfg. & Mine Supply Co.,

DUMPS
United Iron Works, Inc.

DUMPS (Rotary, Cradle, Crossover & Kickback)
C. S. Card Iron Works Co.
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

DUST COLLECTING EQUIPMENT
American Coal Cleaning Corpn.

DUST FILTERS
American Coal Cleaning Corpn.

DYNAMITE
E. I. du Pont de Nemours & Co.
Hercules Powder Co.

DYNAMOS
Allis-Chalmers Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Westinghouse Electric & Mfg. Co.

DYNAMO OILS
Standard Oil Co. (Ind)

ELECTRICAL APPARATUS
Allis-Chalmers Mfg. Co.
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

ELECTRICAL CABLES & WIRES
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.

ELECTRIC BLASTING CAPS
Hercules Powder Co.

ELECTRIC HOISTING MACHINERY
Allis-Chalmers Mfg. Co.

ELECTRIC LOCOMOTIVES
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.

ELECTRIC LOCOMOTIVE CABLES
Roebling's Sons Co., J. A.
Westinghouse Electric & Mfg. Co.

ELECTRIC MINE SUPPLIES
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

ELECTRIC WIRES AND CABLES
General Electric Co.
American Steel & Wire Co.

ELECTRICAL SUPPLIES
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

ELECTRICAL WIRES AND CABLES
Roebling's Sons Co., J. A.

ELECTRODES, WELDING
Roebling's Sons Co., J. A.

ELEVATORS
The Jeffrey Mfg. Co.
Link-Belt Co.

ELEVATORS, BUCKET
The Jeffrey Mfg. Co.
Link-Belt Co.

ELEVATOR CABLES & ROPES
Roebling's Sons Co., J. A.

ELEVATOR AND HOIST MOTORS
Westinghouse Electric & Mfg. Co.

ELEVATOR MACHINERY
Atlas Car & Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

There Are Many Grades *of* Wire Rope

but it's the Right Grade for the Job that Counts!

Solve your Wire Rope problems by using—

AMERICAN

STEEL & WIRE COMPANY

WIRE ROPE

American Steel & Wire Company

Subsidiary of United States Steel Corporation

Sales Offices: Chicago New York Boston Cleveland Worcester Philadelphia Pittsburgh Buffalo Detroit Cincinnati Baltimore Wilkes-Barre St. Louis Kansas City Minneapolis-St. Paul Oklahoma City Birmingham Atlanta Memphis Dallas Denver Salt Lake City

U. S. STEEL PRODUCTS COMPANY
San Francisco, Los Angeles, Portland, Seattle

Export Representatives:
UNITED STATES STEEL PRODUCTS CO., 30 Church St., New York, N. Y.

MT. VERNON

PIT CAR LOADER

THE simplicity of this loader combined with the many operating features, unusual to this type of machine, make it an easily operated mechanization unit—it does not call for skilled mechanics. Let us send you complete details of its unusual operating and construction features.

THE MT. VERNON CAR MFG. CO.
MT. VERNON, ILLINOIS

CONSTRUCTION DETAILS NO. 7
Little to get out of order. Sufficiently enclosed for protection and open enough for ready and quick access to ALL parts.

Easily operated
mechanization

ENGINE OILS
Standard Oil Co. (Ind.)

ENGINES, GAS AND GASOLINE
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.
Westinghouse Electric & Mfg. Co.

ENGINES (Hoisting and Hauling)
Connellsville Mfg. & Mine Supply Co.
Westinghouse Electric & Mfg. Co.

ENGINES, OIL
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.

ENGINES, STEAM
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co.

EXCAVATORS
Link-Belt Co.

EXHAUSTERS
American Coal Cleaning Corpn.

EXPLOSIVES
The E. I. du Pont Powder Co.
Hercules Powder Co.

FAN DRIVES
Link-Belt Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

FANS, Man Cooling
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

FANS, Turbine
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

FANS, VENTILATING
Connellsville Mfg. & Mine Supply Co.
The Jeffrey Mfg. Co.
Robinson Ventilating Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

FEEDERS
Hockensmith Wheel & Mine Car Co.

FEEDERS (Crossover, Kickback, Rotary and Dump)
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.

FEEDERS (Gravity)
American Coal Cleaning Corpn.
Link-Belt Co.

FEEDERS (Hand Operated)
Link-Belt Co.
Mining Safety Device Co.
Roberts & Schaefer Co.

FEEDERS, ORE
The Jeffrey Mfg. Co.
Link-Belt Co.

FEEDERS (Reciprocating)
Link-Belt Co.
American Coal Cleaning Corpn.

FEEDERS (Semi-automatic)
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.

FIBRE GREASES
Standard Oil Co. (Ind.)

FILTER CLOTH, WIRE
Ludlow Saylor Wire Co.

FILTERS (Dust)
American Coal Cleaning Corpn.

FIRE AND WEATHER-PROOF WIRE
Roebling's Sons Co., J. A.

FIRST AID SUPPLIES
Mine Safety Appliances Co.

FITTINGS—WIRE ROPE (Tru-Loc Brand Processed)
American Cable Co.

FITTINGS—WIRE ROPE (Thimbles, Clips, Sockets, Hooks, Shackles Turnbuckles)
American Cable Co.

FLASHLIGHTS AND BATTERIES (Mine Safety)
National Carbon Co., Inc.

FLOTATION MACHINES
Allis-Chalmers Mfg. Co.

FLOTATION OILS
Hercules Powder Co.

FLOW METERS
General Electric Co.

FLUX, WELDING
Oxweld Acetylene Co.

FORGINGS
Allis-Chalmers Mfg. Co.

FROGS
Central Frog & Switch Co.

FROGS AND SWITCHES
C. S. Card Iron Works Co.
Central Frog & Switch Co.
West Virginia Rail Co.

FURNACE OIL
Standard Oil Co. (Ind.)

FURNACES, Oil (for drill steel)
Ingersoll-Rand Co.

FURNACES, ROASTING
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.

GAS (Cutting, Welding)
Prest-O-Lite Co., Inc.

GAS (Nitrogen, Oxygen)
Linde Air Products Co.

GASOLINE
Standard Oil Co. (Ind.)

GAS ENGINE OILS
Standard Oil Co. (Ind.)

GAS MASKS
Mine Safety Appliances Co.

GAUGES, WELDING & CUTTING
Central Frog & Switch Co.

GAUGE RODS
Central Frog & Switch Co.

GAUGES, WELDING & CUTTING
Oxweld Acetylene Co.

GEAR COMPOUNDS
Standard Oil Co. (Ind.)

GEARS
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

GEARS, BEVEL
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.

GEARS (Fabroil & Textolite)
General Electric Co.

GEARS, HERRINGBONE
Link-Belt Co.
Vulcan Iron Works.

GEARS, Machine Cut
Link-Belt Co.
Vulcan Iron Works.

GEARS, Moulded Tooth
Link-Belt Co.
Vulcan Iron Works.

GEARS, Silent Chain
Link-Belt Co.
Morse Chain Co.

GEARS, SPUR
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Vulcan Iron Works.

GEARS, WORM
The Jeffrey Mfg. Co.

GELATIN DYNAMITES
E. I. Du Pont de Nemours & Co.
Hercules Powder Co.

GENERATORS AND GENERATING SETS
Allis-Chalmers Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Westinghouse Electric & Mfg. Co.

GENERATORS, ACETYLENE
Oxweld Acetylene Co.

GLOVES, ASBESTOS
Oxweld Acetylene Co.

GOGGLES, MINERS' WIRE SCREEN, NOD AND SHAKE WELLSWORTH
Mine Safety Appliances Co.

GOGGLES, WELDING
Oxweld Acetylene Co.

GRAPHITE GREASES
Standard Oil Co. (Ind.)

GREASE
Keystone Lubricating Co.
Standard Oil Co. (Ind.)

GREASE CUPS
Keystone Lubricating Co.

GRINDERS, Portable Pneumatic
Ingersoll-Rand Co.

GUARD RAIL CLAMPS
Central Frog & Switch Co.

GUY ROPES, GALVANIZED
American Steel & Wire Co.
Roebling's Sons Co., J. A.

HAMMERS, Calking, Chipping & Riveting
Ingersoll-Rand Co.

HANGERS
Link-Belt Co.

HANGERS (Insulated Trolley)
Ohio Brass Co.

HANGERS, SHAFT, DROP
Link-Belt Co.

HANGERS, SHAFT, POST
Link-Belt Co.

HANGERS, SHAFT, SELF-OILING
Link-Belt Co.

HAULAGE ROPE
American Steel & Wire Co.
Roebling's Sons Co., J. A.

HEADLIGHTS, ARC AND INCANDESCENT
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

HEATER CORD
Roebling's Sons Co., J. A.

HERRINGBONE GEAR DRIVES
Link-Belt Co.

H-H INHALATORS
Mine Safety Appliances Co.

HIGH EXPLOSIVES
E. I. Du Pont de Nemours & Co.
Hercules Powder Co.

HOIST DRIVES
Link-Belt Co.
Vulcan Iron Works.

HOISTING ROPES
American Steel & Wire Co.
Connellsville Mfg. & Mine Supply Co.
Roebling's Sons Co., J. A.

HOISTS
American Steel & Wire Co.
Ingersoll-Rand Co.
Link-Belt Co.
Sullivan Machinery Co.
United Iron Works, Inc.

HOISTS, AIR
Ingersoll-Rand Co.
Sullivan Machinery Co.

HOISTS, ELECTRIC
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
General Electric Co.
Goodman Mfg. Co.
Sullivan Machinery Co.
Vulcan Iron Works

HOISTS, PORTABLE
Ingersoll-Rand Co.
Sullivan Machinery Co.

HOISTS, Room
Vulcan Iron Works.

HOISTS, Room and Gathering
Goodman Mfg. Co.

HOISTS, Scraper-Loader
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co.
Sullivan Machinery Co.

HOISTS, STEAM
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co.
Vulcan Iron Works.

HOLDERS-ON RIVETING
Ingersoll-Rand Co.

HOOKS
Roebling's Sons Co., J. A.

HOOKS, WIRE ROPE
American Cable Co.

HOSE, AIR AND STEAM
Ingersoll-Rand Co.

HOSE, WELDING AND CUTTING
Oxweld Acetylene Co.

HYDRATORS, LIME
Vulcan Iron Works.

IGNITERS, Electric
Hercules Powder Co.

INCINERATORS
Vulcan Iron Works.

INCLINE FROGS
Central Frog & Switch Co.

INCLINE TRACK LAYOUTS
Central Frog & Switch Co.

INSULATORS, FEEDER WIRE
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

INSULATORS, SECTION
American Mine Door Co.
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

INSULATORS (Porcelain)
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

INSULATORS (Third Rail)
General Electric Co.
Ohio Brass Co.

INSULATORS (Trolley)
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

INSULATED WIRE AND CABLE
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.

KEROSENE
Standard Oil Co. (Ind.)

KEYSTONE GREASE
Keystone Lubricating Co.

KEYSTONE GREASE CUPS
Keystone Lubricating Co.

KEYSTONE SAFETY LUBRICATORS
Keystone Lubricating Co.

KILNS (Rotary)
Allis-Chalmers Mfg. Co.
Vulcan Iron Works.

KILNS, VERTICAL
Vulcan Iron Works.

LAMP CORD
American Steel & Wire Co.
Roebling's Sons Co., J. A.

LAMPS, ARC AND INCANDESCENT
General Electric Co.
Westinghouse Electric & Mfg. Co.

LAMPS (Edison Electric)
Mine Safety Appliances Co.

LEAD BURNING APPARATUS, Oxy-Acetylene, Oxy-City Gas
Oxweld Acetylene Co.

LIGHT AND POWER PLANTS (Small)
Westinghouse Electric & Mfg. Co.

LIGHT STEEL ANGLES
Carnegie Steel Co.

LIGHT STEEL RAILS
Carnegie Steel Co.
West Virginia Rail Co.

LOADERS, Gravel and Sand
Joy Manufacturing Co.
Link-Belt Co.

LOADERS (Mine Car)
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Joy Manufacturing Co.
Link-Belt Co.
Myers-Whaley Co.

LOADERS, PORTABLE
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Joy Manufacturing Co.
Link-Belt Co.
Myers-Whaley Co.

LOADERS, Snow
Joy Manufacturing Co.

LOADERS, Truck
Joy Manufacturing Co.
Link-Belt Co.

LOADERS, Wagon
Joy Manufacturing Co.
Link-Belt Co.

LOADING BOOMS
Connellsville Mfg. & Mine Supply Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.
United Iron Works, Inc.

LOADING MACHINES
Connellsville Mfg. & Mine Supply Co.
Conveyor Sales Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Myers-Whaley Co.

LOCOMOTIVES, ELECTRIC
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.

LOCOMOTIVES, GASOLINE
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

LOCOMOTIVES, RACK RAIL
Atlas Car & Mfg. Co.
Goodman Mfg. Co.

LOCOMOTIVES, STEAM
Vulcan Iron Works.

LOCOMOTIVES, STORAGE BATTERY
Atlas Car & Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

LOCOMOTIVE SWITCHING & WRECKING ROPES
Roebling's Sons Co., J. A.

LOCOMOTIVES (Third Rail)
Atlas Car & Mfg. Co.
Goodman Mfg. Co.

LOCOMOTIVES, TROLLEY
Atlas Car & Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

LONGWALL MACHINES
Goodman Mfg. Co.
Sullivan Machinery Co.

LUBRICANTS
Keystone Lubricating Co.
Standard Oil Co. (Ind.)

LUBRICATING DEVICES
Keystone Lubricating Co.

LUBRICATING GREASES
Keystone Lubricating Co.

LUBRICATING ENGINEERS
Keystone Lubricating Co.

WEBSTER
CAR RETARDERS
Save Lives, Time and Money

One man controls the movement of the cars—inch by inch if necessary—eliminating breakage and assuring well loaded cars without spillage. The car trimmer controls the car from a position of safety, safe from the dangers of runaway cars, faulty brakes, slippery tracks, etc.

Easy to Install

Send for Car Retarder Circular

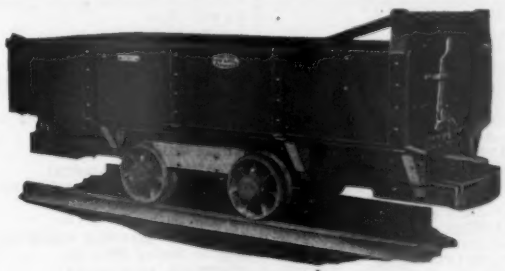
We Design and Make Complete Tipple Equipment

The Webster Mfg. Company

1856 N Kostner Ave. **CHICAGO, ILL.**

Sole Manufacturers of

Oldroyd Coal Cutters and Loaders



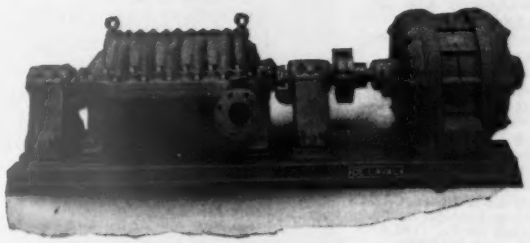
PHILLIPS
MINE AND MILL SUPPLY COMPANY

Pittsburgh, Pa.

Phillips Steel Cars are fabricated over duplicating machines, and interchangeability of replacing parts can always be depended upon. Phillips parts fit Phillips cars!

Write for Prices

2 De Laval Five Stage PUMPS



deliver 1000 gallons per minute each against 1130 ft. head at the Bisbee mine of the Phelps Dodge Company

DE LAVAL MULTISTAGE MINE PUMPS

are characterized by:

1. **Perfect mechanical and hydraulic balance, no water-cooled bearings required.**
2. **High efficiency.**
3. **Simplicity of construction.**
4. **Large internal clearances, made possible by the use of labyrinth wearing rings.**
5. **Relatively low pressures per stage,—lower velocities mean longer life.**
6. **Stuffing boxes under suction pressure only.**
7. **Wearing parts manufactured to limit gages and interchangeable.**
8. **Careful testing before shipment.**

Ask for Catalog E-1123

De Laval
Steam Turbine Company
Canadian Works - Peterborough, Ont.

Local Offices: Atlanta, Boston, Charlotte, Chicago, Cleveland, Duluth, Havana, Helena, Honolulu, Houston, Kansas City, Los Angeles, Montreal, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., St. Paul, Salt Lake City, San Francisco, Seattle, Spokane, Toronto, Vancouver.

3010

Manufacturers of Steam Turbines, Centrifugal Pumps, Centrifugal Blowers and Compressors, Flexible Couplings, Double Helical Speed Reducing Gears, Worm Gears, Hydraulic Turbines and Special Centrifugal Machinery.

LUBRICATORS
Keystone Lubricating Co.
MACHINE OILS
Standard Oil Co. (Ind.)
MACHINERY, TRANSMISSION (Power)
Allis-Chalmers Mfg. Co.
Link-Belt Co.
Morse Chain Co.
MANIFOLDS, OXYGEN
Oxweld Acetylene Co.
MAST ARM ROPE, Galvanized
Roebling's Sons Co., J. A.
METHANE RECORDER, CONTINUOUS
Mine Safety Appliances Co.
MILL GREASES
Standard Oil Co. (Ind.)
MILLS, ROD & BALL
Allis-Chalmers Mfg. Co.
MILLS, STAMPS
Allis-Chalmers Mfg. Co.
MINE CAR AXLES
Hockensmith Wheel & Mine Car Co.
MINE CAR BEARINGS
Hyatt Roller Bearing Co.
Timken Roller Bearing Co.
MINE CAR BOXES
Hockensmith Wheel & Mine Car Co.
MINE CAR FORGINGS
Hockensmith Wheel & Mine Car Co.
MINE CAR LUBRICANTS
Keystone Lubricating Co.
Standard Oil Co. (Ind.)
MINE CAR PARTS
C. S. Card Iron Works Co.
Hockensmith Wheel & Mine Car Co.
Phillips Mine & Mill Supply Co.
MINE CARS
Atlas Car & Mfg. Co.
C. S. Card Iron Works Co.
Enterprise Wheel & Car Corpn.
Hockensmith Wheel & Mine Car Co.
Phillips Mine & Mill Supply Co.
United Iron Works, Inc.
MINE CAR TRUCKS
United Iron Works, Inc.
MINE CAR WHEELS
C. S. Card Iron Works Co.
Hockensmith Wheel & Mine Car Co.
United Iron Works, Inc.
MINE DOORS, AUTOMATIC
American Mine Door Co.
MINE LOCOMOTIVE CABLE
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.
MINE TIES
Central Frog & Switch Co.
MINE TIES, CREOSOTE TREATED
Ayer & Lord Tie Co.
MINING & METALLURGICAL MACHINERY
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.
MINING EQUIPMENT
Allis-Chalmers Mfg. Co.
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Westinghouse Electric & Mfg. Co.
MINING MACHINE CABLE
General Electric Co.
Roebling's Sons Co., J. A.
MINING MACHINES
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Sullivan Machinery Co.
MINING MACHINES (Electric)
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Westinghouse Electric & Mfg. Co.
MINING MACHINES (Government Approved)
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
MINING MACHINERY
Goodman Mfg. Co.
Ingersoll-Rand Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Westinghouse Electric & Mfg. Co.
MINING MACHINERY BEARINGS
Hyatt Roller Bearing Co.
MINING MACHINERY LUBRICANTS
Keystone Lubricating Co.
MINING MACHINE ROPES
American Cable Co.
MINING POSTS, CREOSOTE TREATED
Ayer & Lord Tie Co.
MINING ROPES (Haulage, Shaft Hoist, Mining Machine, Slusher)
American Cable Co.
MINING TIMBERS, CREOSOTE TREATED
Ayer & Lord Tie Co.
MOTOR OILS
Standard Oil Co. (Ind.)
MOTORS
Allis-Chalmers Mfg. Co.
General Electric Co.
Goodman Mfg. Co.
Westinghouse Electric & Mfg. Co.
MOTORS, Electric
Westinghouse Electric & Mfg. Co.
MOUNTED BOTTOM CUTTERS
Goodman Mfg. Co.
MOVING PICTURE CORD
American Steel & Wire Co.
Roebling's Sons Co., J. A.
NITROGEN GAS
Linde Air Products Co.
OILS
Standard Oil Co. (Ind.)
ORE, BUYERS AND SELLERS OF
Irvington Smelt. & Ref. Works.
OVERCUTTING MACHINES
Goodman Mfg. Co.
Sullivan Machinery Co.
OXYGEN GAS
Linde Air Products Co.
OXYGEN BREATHING APPARATUS, McCAA TWO-HOUR
Mine Safety Appliances Co.
OXY-ACETYLENE APPARATUS and SUPPLIES
Oxweld Acetylene Co.
PAVING BREAKERS
Ingersoll-Rand Co.
Sullivan Machinery Co.
PERFORATED METAL
Allis-Chalmers Mfg. Co.
PERMISSIBLES, Explosives
The E. I. Du Pont Powder Co.
Hercules Powder Co.
PETROLATUMS
Standard Oil Co. (Ind.)
PICKING TABLES
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.
United Iron Works, Inc.
PIPE (Genuine Wrought Iron)
A. M. Byers Co.
PIPE (Wood)
Connellsville Mfg. & Mine Supply Co.
PNEUMATIC COAL SEPARATING MACHINERY
American Coal Cleaning Corp.
PNEUMATIC SIZING MACHINERY
American Coal Cleaning Corp.
PNEUMATIC TOOL
Ingersoll-Rand Co.
PNEUMATIC TOOL LUBRICANT
Standard Oil Co. (Ind.)
PORTABLE TRACK
Central Frog & Switch Co.
PORTABLE TURNOUTS
Central Frog & Switch Co.
POSTS, CREOSOTE TREATED
Ayer & Lord Tie Co.
POWDER, BLASTING
E. I. Du Pont de Nemours & Co.
Hercules Powder Co.
POWER CABLES
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.
POWER SHOVELS
Link-Belt Co.
POWER TRANSMISSION MACHINERY
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Morse Chain Co.
Westinghouse Electric & Mfg. Co.
PREHEATING APPARATUS
Oxweld Acetylene Co.
PRESSURE GUN GREASE
Standard Oil Co. (Ind.)
PROSPECTIVE DRILLS
Hoffman Bros. Drilling Co.
Ingersoll-Rand Co.
Pennsylvania Drilling Co.
PULLEYS
Link-Belt Co.
PULLEYS, CLUTCH, FRICTION
Link-Belt Co.
PULVERIZERS, COAL AND COKE
The Jeffrey Mfg. Co.
PUMPS, Acid Resisting
Ingersoll-Rand Co.
PUMPS, AIR LIFT
Ingersoll-Rand Co.
Sullivan Machinery Co.
PUMPS, Boiler Feed
Ingersoll-Rand Co.
Westinghouse Electric & Mfg. Co.
PUMPS, CENTRIFUGAL
Allis-Chalmers Mfg. Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, DEEP WELL
Ingersoll-Rand Co.
PUMPS (Electric)
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
Westinghouse Electric & Mfg. Co.
PUMPS, Fire
Ingersoll-Rand Co.
PUMPS (Gathering or Dip)
Connellsville Mfg. & Mine Supply Co.
PUMPS, Inclined Shaft
Ingersoll-Rand Co.
PUMPS, MINE
Allis-Chalmers Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, Sinking
Ingersoll-Rand Co.
PUMPS, PNEUMATIC AIR LIFT
Ingersoll-Rand Co.
PUMPS, POWER
Connellsville Mfg. & Mine Supply Co.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, SAND
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, STEAM
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works).
PUMPS, VACUUM
Ingersoll-Rand Co.
PUNCHES, Drill Steel
Ingersoll-Rand Co.
Sullivan Machinery Co.
QUARRYING MACHINERY
Ingersoll-Rand Co.
Sullivan Machinery Co.
QUARTZ CRYSTAL
Diamond Drill Carbon Co.
RAIL BONDS
American Steel & Wire Co.
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.
RAIL BRACES
Central Frog & Switch Co.
RAILWAY SUPPLIES
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.
RAILWAY TIES, CREOSOTE TREATED
Ayer & Lord Tie Co.
RAMMERS, Pneumatic
Ingersoll-Rand Co.
RECEIVERS, AIR
Ingersoll-Rand Co.
REGULATORS, Welding and Cutting, Compressed Gas
Oxweld Acetylene Co.
REHEATERS, Air
Ingersoll-Rand Co.
REINFORCING BARS
West Virginia Rail Co.
RESCUE APPARATUS
Link-Belt Co.
Mine Safety Appliances Co.
RETARDERS
Mining Safety Device Co.
Roberts & Schaefer Co.
RIVER CROSSING SUSPENSION WIRE, Galvanized
Roebling's Sons Co., J. A.
ROCK CARS
United Iron Works, Inc.
ROCK-DISPOSAL EQUIPMENT
Link-Belt Co.
Roberts & Schaefer Co.
ROCK DOORS
United Iron Works, Inc.
ROCK DRILLS
Ingersoll-Rand Co.
ROCK DUSTING EQUIPMENT
American Mine Door Co.
Mine Safety Appliances Co.
RODS, WELDING
Ohio Brass Co.
Oxweld Acetylene Co.
ROLLER BEARINGS
Enterprise Wheel & Car Corporation.
Hyatt Roller Bearing Co.
Timken Roller Bearing Co.
ROLLERS
C. S. Card Iron Works Co.
ROLLS (Crushing)
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
ROPE
American Steel & Wire Co.
ROPE GREASE
Keystone Lubricating Co.
ROPE, MINING (Haulage, Shaft Hoist, Mining Machine, Slusher)
American Cable Co.
ROPE, SWITCH WIRE
American Cable Co.
ROPE, TOWING WIRE
American Cable Co.
ROPE, TRANSMISSION
American Steel & Wire Co.
Roebling's Sons Co., J. A.
ROPE, WIRE
American Steel & Wire Co.
Roebling's Sons Co., J. A.
ROPE, WIRE (Crescent Brand Ordinary)
American Cable Co.
ROPE, WIRE (Plain or Galvanized)
American Cable Co.
ROPE, WIRE (Tru-Lay Brand Preformed)
American Cable Co.
ROTARY COOLERS
Vulvan Iron Works.
ROTARY DRYERS
Vulcan Iron Works.
ROTARY DUMPS
C. S. Card Iron Works Co.
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.
ROTARY ROASTERS
Vulcan Iron Works.
RUNNING ROPE, Galvanized
American Steel & Wire Co.
Roebling's Sons Co., J. A.
SAFETY APPLIANCES, MINE
Connellsville Mfg. & Mine Supply Co.
SAFETY FUSE
Hercules Powder Co.
SAFETY FUSE & WIRES—LEADING & CONNECTING
E. I. Du Pont de Nemours & Co.
SAFETY LUBRICATORS
Keystone Lubricating Co.
SAND DRYERS
Roberts & Schaefer Co.
SASH CORD
Roebling's Sons Co., J. A.
SAWS (Air)
Ingersoll-Rand Co.
SCRAPER LOADERS
Goodman Mfg. Co.
Sullivan Machinery Co.
SCREEN BARS
Phillips Mine & Mill Supply Co.
SCREENS
United Iron Works, Inc.
SCREENS (Anti-Gravity)
American Coal Cleaning Corpn.
SCREENS, ARCH-CRIMP
Ludlow Saylor Wire Co.
SCREENS, DOUBLE CRIMPED
Ludlow Saylor Wire Co.
SCREENS, HORIZONAL
Link-Belt Co.
Roberts & Schaefer Co.
W. S. Tyler Co.
SCREENS, PERFORATED METAL
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
SCREENS, REK-TANG
Ludlow Saylor Wire Co.
SCREENS, REVOLVING
Allis-Chalmers Mfg. Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
SCREENS, SHAKER
C. S. Card Iron Works Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.
SCREENS AND PERFORATED SHEETING
Allis-Chalmers Mfg. Co.
SCREENS (Vibrating)
American Coal Cleaning Corpn.
Link-Belt Co.
W. S. Tyler Co.
SCREENS & WASHERIES
Koppers-Rheolaveur Co.
Link-Belt Co.
Roberts & Schaefer Co.
SCREENS, WOVEN WIRE
Ludlow Saylor Wire Co.
SEIZING STRAND, GALVANIZED
Roebling's Sons Co., J. A.

ELECTRI -- THROW

The Canton Automatic Switch Thrower—Electrically Operated

FOOL PROOF. An automatic relay switch within the casing, cuts the power from the coils at the same time the switch points are thrown. The contact is broken through the relay switch making no flash on the trolley line. Many more features worth investigation. Trains do not stop for switches when they are controlled with the Electri-throw. Motorman does not stop his trip nor slow it down to pass through the Electri-throw.

Speed the Haulage BUT Speed it Safely

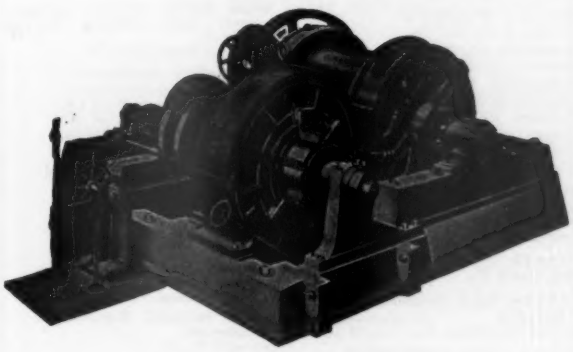
REMOTE CONTROL of your haulage through a **DISPATCHER** may be accomplished by using Canton Automatic Signals and Switch Throwers. Confer with us. We can help you. Send for catalogue today and learn how to

CONSERVE LIFE-LABOR-TIME

The American Mine Door Company, 2063 Dueber Avenue, Canton, Ohio

The Connellsville Manufacturing and Mine Supply Company

Connellsville, Pa.



If you need any cost reducing mine equipment, write us

The Cage, Hoist and Fan Builder

Special Fans:

1600° Fahr.

As pioneers in special alloy fan equipment, we are prepared to offer you expert engineering advice and special alloy fan equipment to withstand the severe requirements of the ore smelters.

Let us handle your special problems

ROBINSON

VENTILATING COMPANY

Zelienople -:- -:- Pennsylvania

SELF-RESCUERS
Mine Safety Appliances Co.

SHACKLES, WIRE ROPE
American Cable Co.

SHAFT HOIST ROPES
American Cable Co.

SHARPENERS, DRILL
Ingersoll-Rand Co.
Sullivan Machinery Co.

SHEAVES
C. S. Card Iron Works Co.
Hockensmith Wheel & Mine Car Co.
Roebling's Sons Co., J. A.
Vulcan Iron Works.

SHEAVE WHEELS
Hockensmith Wheel & Mine Car Co.
Vulcan Iron Works.

SHEAVE WHEELS, CAST IRON
United Iron Works, Inc.

SHORTWALL MACHINES
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Hyatt Roller Bearing Co.
Sullivan Machinery Co.

SHOVELS, ELECTRIC
Myers-Whaley Co.

SHOVEL—ELECTRO-HYDRAULIC
Goodman Mfg. Co.

SIGNAL WIRES AND CABLES
American Steel & Wire Co.
General Electric Co.
Roebling's Sons Co., J. A.

SIGNS
Mine Safety Appliances Co.

SIGNS (Mine)
Stonehouse Signs, Inc.

SINKERS, ROCK DRILL
Ingersoll-Rand Co.

SKIPS
Allis-Chalmers Mfg. Co.
Atlas Car & Mfg. Co.
Connellsville Mfg. & Mine Supply Co.
Link-Belt Co.
Roberts & Schaefer Co.
Vulcan Iron Works.

SKIP LOADING EQUIPMENT
Atlas Car & Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

SLABBING MACHINES
Goodman Mfg. Co.

SLINGS, WIRE ROPE
American Cable Co.

SLUSHER ROPES
American Cable Co.

SMELTERS
Irvington Smelt. & Ref. Works.

SOCKETS, Open and Closed
Roebling's Sons Co., J. A.

SOCKETS, WIRE ROPE
American Cable Co.

SPECIAL MACHINERY
Vulcan Iron Works.

SPEED REDUCERS, DOUBLE
Link-Belt Co.
Morse Chain Co.

SPEED REDUCERS, SINGLE
Link-Belt Co.
Morse Chain Co.

SPIKES
West Virginia Rail Co.

SPLICE BARS (Plain and Angle)
Carnegie Steel Co.
Central Frog & Switch Co.
West Virginia Rail Co.

SPLICE, CABLE
American Mine Door Co.
Ohio Brass Co.

SPLICE, INSULATOR
American Mine Door Co.

SPLICE, TROLLEY WIRE
General Electric Co.
Ohio Brass Co.

SPLICERS, TROLLEY
American Mine Door Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

SPROCKETS, CLAMP HUB
Link-Belt Co.
Morse Chain Co.

SPROCKETS, COMPENSATING
Link-Belt Co.
Morse Chain Co.

SPROCKETS (Shearing Pin)
Link-Belt Co.
Morse Chain Co.

SPROCKETS, SILENT CHAIN
Link-Belt Co.
Morse Chain Co.

SPROCKETS, SPRING
Link-Belt Co.
Morse Chain Co.

SPUR GEAR DRIVES
Link-Belt Co.

STARTER CABLES
Roebling's Sons Co., J. A.

STEAM CYLINDER OILS
Standard Oil Co. (Ind.)

STEEL, ALLOY
Timken Roller Bearing Co.

STEEL CROSS TIES
Carnegie Steel Co.
West Virginia Rail Co.

STEEL, ELECTRIC FURNACE
Timken Roller Bearing Co.

STEEL, HOLLOW AND SOLID DRILL
Ingersoll-Rand Co.

STEEL, NICKEL
Timken Roller Bearing Co.

STEEL, NICKEL, MOLYBDENUM
Timken Roller Bearing Co.

STEEL, OPEN HEARTH
Timken Roller Bearing Co.

STEEL, REINFORCING
American Mine Door Co.

STEEL, SHAPES, PLATES, BARS, ETC.
Carnegie Steel Co.

STEEL, Special Analysis
Timken Roller Bearing Co.

STEEL TIES AND REINFORCEMENTS
Carnegie Steel Co.
West Virginia Rail Co.

STOPERS, ROCK DRILL
Ingersoll-Rand Co.
Sullivan Machinery Co.

STORAGE BATTERY LOCOMOTIVES
Atlas Car & Mfg. Co.
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Vulcan Iron Works.
Westinghouse Electric & Mfg. Co.

STRAND
American Steel & Wire Co.
Roebling's Sons Co., J. A.

SWITCHBOARD WIRE AND CABLES
American Steel & Wire Co.
Roebling's Sons Co., J. A.
Westinghouse Electric & Mfg. Co.

SWITCHBOARDS, POWER
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.

SWITCHES
C. S. Card Iron Works Co.
Central Frog & Switch Co.

SWITCHES, ALTERNATING
Mining Safety Device Co.

SWITCHES (Disconnecting and Electric)
General Electric Co.
Westinghouse Electric & Mfg. Co.

SWITCHES AND FROGS, TROLLEY
American Mine Door Co.
Central Frog & Switch Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

TACKLE BLOCKS
Roebling's Sons Co., J. A.

TELEGRAPH AND TELEPHONE WIRES AND CABLES
American Steel & Wire Co.
Roebling's Sons Co., J. A.

TELEPHONE CORDS
American Steel & Wire Co.
Roebling's Sons Co., J. A.

THIMBLES
American Steel & Wire Co.
Roebling's Sons Co., J. A.

TIES (Steel, Mine)
Carnegie Steel Co.
Central Frog & Switch Co.

TILLER ROPE
Roebling's Sons Co., J. A.

TIMBER, CREOSOTE TREATED
Ayer & Lord Tie Co.

TIMBER PRESERVING EQUIPMENT
Allis-Chalmers Mfg. Co.

TIMBERS, STEEL MINE
Carnegie Steel Co.

TIPPLES
American Coal Cleaning Corp.
The Jeffrey Mfg. Co.
Link-Belt Co.
Roberts & Schaefer Co.

TIPPLE EQUIPMENT
American Coal Cleaning Corp.
C. S. Card Iron Works Co.
The Jeffrey Mfg. Co.
Link-Belt Co.
Mining Safety Device Co.
Phillips Mine & Mill Supply Co.
Roberts & Schaefer Co.
United Iron Works, Inc.

TIPPLE TRACK
Central Frog & Switch Co.

TIRE WIRES
Roebling's Sons Co., J. A.

TOOLS, Blacksmiths (for drill steel)
Ingersoll-Rand Co.

TORCHES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co.

TRACK BRACES
Central Frog & Switch Co.

TRACK EQUIPMENT
Carnegie Steel Co.
Central Frog & Switch Co.
C. S. Card Iron Works Co.
West Virginia Rail Co.

TRACK LAYOUTS (Industrial)
Central Frog & Switch Co.

TRACKS, PORTABLE, RAIL, ETC.
Carnegie Steel Co.
Central Frog & Switch Co.
West Virginia Rail Co.

TRACK (Portable)
Carnegie Steel Co.
Central Frog & Switch Co.

TRACK (Portable, Assembled and Unassembled, Riveted or Bolted)
Carnegie Steel Co.
Central Frog & Switch Co.
West Virginia Rail Co.

TRACK SUPPLIES
Carnegie Steel Co.
Central Frog & Switch Co.
West Virginia Rail Co.

TRAMWAYS, AERIAL
American Steel & Wire Co.

TRANSFORMER OILS
Standard Oil Co. (Ind.)

TRANSFORMERS
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.

TRANSMISSION OILS AND GREASES
Standard Oil Co. (Ind.)

TRANSMISSION, SILENT CHAIN
Link-Belt Co.
Morse Chain Co.

TROLLEY FROGS
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

TROLLEY (Hangers and Clamps)
General Electric Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

TROLLEY MATERIAL, OVERHEAD
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

TROLLEY WHEELS AND HARPS
Goodman Mfg. Co.
The Jeffrey Mfg. Co.
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

TROLLEY WIRE
American Steel & Wire Co.
Roebling's Sons Co., J. A.

TRUCKS, WELDER'S
Oxweld Acetylene Co.

TURBINE BLOWERS
Robinson Ventilating Co.

TURBINES, HYDRAULIC
Allis-Chalmers Mfg. Co.
Standard Oil Co. (Ind.)

TURBINES, STEAM
Allis-Chalmers Mfg. Co.
Westinghouse Electric & Mfg. Co.

TURNBUCKLES—WIRE ROPE
American Cable Co.
American Steel & Wire Co.
Roebling's Sons Co., J. A.

VALVES
Ohio Brass Co.

VALVES, Back Pressure, Pressure Reducing
Oxweld Acetylene Co.

VENTILATING EQUIPMENT
The Jeffrey Mfg. Co.
Robinson Ventilating Co.
Westinghouse Electric & Mfg. Co.

VISES, Riggers
Roebling's Sons Co., J. A.

WAGON LOADERS
The Jeffrey Mfg. Co.
Link-Belt Co.

WASHERIES
Allis-Chalmers Mfg. Co.
American Coal Cleaning Corp.
Link-Belt Co.
Roberts & Schaefer Co.

WEIGH BASKETS
Link-Belt Co.
Roberts & Schaefer Co.

WEIGH HOPPERS
Link-Belt Co.
Phillips Mine & Mill Supply Co.

WEIGHING PANS AND SCALES
United Iron Works, Inc.

WELDING CARBONS (for Electric Arc and Gas Welding Operations)
National Carbon Co., Inc.

WELDING and CUTTING APPARATUS, Etc. (Oxy-Acetylene)
Oxweld Acetylene Co.

WELDING APPARATUS, ELECTRIC ARC
Ohio Brass Co.
Westinghouse Electric & Mfg. Co.

WELDING SUPPLIES
Oxweld Acetylene Co.
Westinghouse Electric & Mfg. Co.

WELDING WIRE, Electric
American Steel & Wire Co.
Ohio Brass Co.
Roebling's Sons Co., J. A.

WELDING WIRE, Gas
American Steel & Wire Co.
Ohio Brass Co.
Roebling's Sons Co., J. A.

WELL DRILLS, for Water, Well and Gas
Pennsylvania Drilling Co.

WHEELS, Cast Iron
Link-Belt Co.
Phillips Mine & Mill Supply Co.

WHEELS OF ALL DESCRIPTION
C. S. Card Iron Works Co.
Hockensmith Wheel & Mine Car Co.

WHEELS, Roller Bearing
Hockensmith Wheel & Mine Car Co.
Phillips Mine & Mill Supply Co.

WHEELS, STEEL, MINE CAR & LOCOMOTIVES
Carnegie Steel Co.

WIRE AND CABLE
American Steel & Wire Co.
Roebling's Sons Co., J. A.

WIRE CLOTH
Ludlow Saylor Wire Co.

WIRE, LEADING & CONNECTING
Hercules Powder Co.

WIRE ROPE
American Steel & Wire Co.

WIRE ROPE, Crescent Brand Ordinary
American Cable Co.

WIRE ROPE, in Special and Standard Construction for all purposes
Roebling's Sons Co., J. A.

WIRE ROPE DRESSING
Standard Oil Co. (Ind.)

WIRE ROPE FITTINGS
American Cable Co.
American Steel & Wire Co.
Roebling's Sons Co., J. A.

WIRE ROPE, MINING (Haulage, Shaft Hoist, Mining Machine, Slusher)
American Cable Co.

WIRE ROPE SLINGS
American Cable Co.
American Steel & Wire Co.
Roebling's Sons Co., J. A.

WIRE ROPE TRAMWAYS
American Steel & Wire Co.

WIRE ROPE, Tru-Lay Brand Preformed
American Cable Co.

WIRE STRAND
American Cable Co.

WIRE, WELDING
American Steel & Wire Co.
Oxweld Acetylene Co.
Roebling's Sons Co., J. A.

WOOD BORING MACHINES, Pneumatic
Ingersoll-Rand Co.

WOOL GREASE
Keystone Lubricating Co.
Standard Oil Co. (Ind.)

WOOL YARN ELASTIC GREASE
Keystone Lubricating Co.

WRECKING FROGS
Johnson Wrecking Frog Co.

WOVEN WIRE SCREENS
Ludlow Saylor Wire Co.

WRENCHES, ALLIGATOR
Roebling's Sons Co., J. A.

YARN GREASES
Standard Oil Co. (Ind.)

ADVANTAGES of CARBON for DRILLING

Guarantee

OUR Tested Carbons (Black Diamonds) are guaranteed. There is no blind chance-taking, for satisfaction is guaranteed or money is cheerfully refunded. Such is our faith in the character of our stones. Unless the best stones are used drilling costs increase.

We are direct Importers of

CARBONS
BORTZ
BALLAS

Write for thirty-six page booklet.

THE DIAMOND DRILL CARBON CO.
67 PARK ROW, NEW YORK, N. Y.

PATRICK CARBON
for Diamond Core Drilling

EVERY Diamond Driller knows the importance of using only high-grade Black Diamonds. The constantly increasing demand for Patrick Carbon is proof of the complete satisfaction it gives.

Patrick Carbon is Dependable. You can rely on it to get the best results.

"How to Cut Carbon Costs," a new Patrick booklet on Drilling Efficiency, is mailed on request.

Write or wire if a Patrick representative is wanted.

Specify Patrick Carbon

R. S. PATRICK
Duluth, Minnesota, U.S.A.
Cable Address, "Exploring" Duluth

Just "Hammer It"

Hammer the clip and the rail is fastened—

if you are using WEST VIRGINIA steel mine ties. Square shoulders hold track positively to correct gage. No spreading of rails. Pressure on rail cannot loosen tie. Low in ultimate cost. Meets all requirements with five styles and four sections.

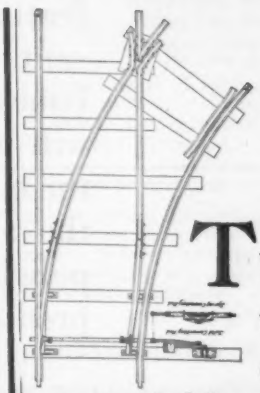
FOR ALL RAILS UP TO SEVENTY POUND
Sec. A1—8 to 20 lb. rail
Sec. B1—20 to 30 lb. rail
Sec. B2—35 and 40 lb. rail
Sec. T6—45 to 70 lb. rail

New folder just published on Main Haulage Ties

Send for data and quotations on all West Virginia Track Work

The West Virginia Rail Co.
Huntington, W. Va.

W.VA.RAIL



TURNOUTS are the places where derailments are most liable to occur. A well made turnout of proper curvature allows more speed and eliminates derailment danger. Consult our engineers in planning improvements and our catalog for equipment that can be shipped promptly.

THE CENTRAL FROG & SWITCH CO.
CINCINNATI, OHIO

CENTRAL
MINE TRACK EQUIPMENT

Some notes on our 1930 PROGRAM

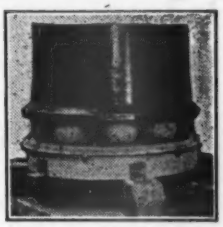
Things happen when a business or an industry becomes conscious of itself—awakens to its inherent possibilities. Progress, sometimes phenomenal, results—has already resulted for some branches of the mining industry!

The 1930 program of THE MINING CONGRESS JOURNAL will present possibly the most comprehensive picture ever drawn of the mining industry. It will help to create a mining mindedness that will benefit every one engaged in the industry. The complete story of different branches, featuring each time some large and representative producer will appear in various issues throughout the year. Everything will be told, from the economic aspects of the entire branch of the industry, through the administrative, personnel and safety policies to the practical methods of actual production of the company featured.

Watch for these important issues already scheduled for 1930 in

THE MINING CONGRESS JOURNAL

BITUMINOUS COAL
COPPER
ANTHRACITE
LEAD and ZINC
IRON *These in addition to the regular Coal Exposition Issue*



ELLIS
BALL-CHILI
MILLS

Giant Mill—equal to 100 Stamps.
18,000 lbs.; 25-H.P. $5000.
Little Giant Mill—35 Stamps.
9400 lbs.; 10-H.P. $2500.
C-I Mill—10 Stamps.
2300 lbs., $995.
B-I Mill—5 Stamps.
1450 lbs., $550.
Independence Mill—5 ton.
450 lbs.; ½-H.P., $285.
Full Plant—
2-H.P. engine, 4x6 Rockbreaker, feeder, etc.
$635

OVER 300 ELLIS MILLS IN USE

ELLIS MILLS MFG. CO.

MAIL ADDRESS: 147 Prospect Ave. SAN FRANCISCO, CALIF. SHOW ROOM: 565 Bryant St.

AYER & LORD TIE CO.

INCORPORATED 1893

CHICAGO

Railroad Cross Ties Lumber Poles

Bridge Timbers Car Stocks Piling and Posts Mine Timbers

TREATING PLANTS

Carbondale, Ill. Grenada, Miss. North Little Rock, Ark. Louisville, Ky. Montgomery, Ala.

"Creosote Oil Prevents Decay"

Irvington Smelting and Refining Works

Buyers, Smelters and Refiners of
Gold, Silver, Lead, Copper and Platinum Ores, Sweeps and Bullion

Manufacturers of Copper Sulphate

IRVINGTON :-: NEW JERSEY

NEW YORK OFFICE—Charles Engelhard
Hudson Terminal Building 30 Church Street

CARD

DENVER

"Low Cost Per Ton Mile Haul" is an accomplished fact in coal and metal mines standardizing on Card cars, wheels, rollers and sheaves, tipple equipment, and trackwork. Thirty-seven years experience with western mining conditions. Write C. S. Card Iron Works Co., 2501 W. 16th Ave., Denver for catalog "J".

Phelps Dodge Corporation

99 JOHN STREET - - NEW YORK

MEMBER COPPER & BRASS RESEARCH ASSOCIATION

Copper

"C ★ Q" Electrolytic

"P. D. Co." Casting

GEORGE WATKIN EVANS

CONSULTING COAL MINING ENGINEER

SMITH TOWER, SEATTLE, U. S. A.
250 PARK AVENUE, NEW YORK

Specialist in Examinations of Coal Properties, Development and Operating Problems, Appraisals, Management, Anthracite and Bituminous Mines. United States and Canada.

Electric railways, public utilities, water, timber, oil, industrial and Mining enterprises *promoted.* Approved *bond and stock issues* placed with European bankers and brokers. Underwriting procured for corporations. Mining and other examinations and reports made by well known engineers.

J. T. BYRNE

74 LOWER LEESON ST. DUBLIN, I. F. S.

DIAMOND CORE DRILLING

CONTRACTORS

We make Borings for Coal, Clays and all Minerals. Up-to-date Equipment. Gasoline, Steam and Electric Outfits. Ask us for estimates.

MOTT CORE DRILLING COMPANY
HUNTINGTON, W. VA.

We Look Into the Earth

By using Diamond Core Drills. We prospect Coal and Mineral Lands in any part of North or South America.

Pennsylvania Drilling Co.
Pittsburgh, Pa.
Drilling Contractors

ORVIS C. HOFFMAN, Pres. LEON H. HOFFMAN, Treas.

HOFFMAN·BROS·DRILLING·CO.

PUNXSUTAWNEY, PA.

DIAMOND CORE DRILLING

CONTRACTORS

PROSPECTING FOR ANY MINERAL. MORE THAN 20 YEARS EXPERIENCE. SATISFACTION GUARANTEED.

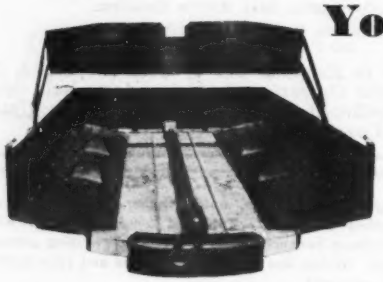
Stonehouse SIGNS, INC.

Stock and Special Signs, Codes, Etc., for Mines

INDEX TO ADVERTISERS

	Page
Allis Chalmers Mfg. Co.	Inside Back Cover
American Cable Co., Inc.	44
American Mine Door Co., The	55
American Steel & Wire Co.	51
Atlas Powder Co.	27
Ayer & Lord Tie Co.	57
Bethlehem Steel Co.	45
Butchart Mfg. Co.	28
Byrne, J. T.	59
Canam Metals Corp.	40
Canam-Mex Mines Corp.	40
Card Iron Works, C. S.	59
Carnegie Steel Co.	16
Central Frog & Switch Co., The	57
Cole, D.	24
Commerce Mining & Royalty Co.	38
Connellsville Mfg. & Mine Supply Co., The	55
Conveyor Sales Co.	17
DeLaval Steam Turbine Co.	53
Diamond Drill Carbon Co., The	57
Dorr Co., The	31
Eagle-Picher Lead Co., The	37, 39
Ellis Mill Mfg. Co.	59
Enterprise Wheel & Car Corp.	60
Evans, Geo. Watkin	59
Fairbanks, Morse & Co.	29
General Electric Co.	20, 21
Goodman Mfg. Co.	13
Hercules Powder Co.	14
Hoffman Bros. Drilling Co.	59
Ingersoll-Rand Co.	32
Interstate Zinc & Lead Co.	42
Irvington Smelt. & Ref. Works	59
Jeffrey Mfg. Co.	7, 9

	Page
Joy Mfg. Co.	6
Keystone Lubricating Co.	18
Koppers-Rheolaveur Corp.	10, 11
LaBour Co., Inc., The	47
Link-Belt Co.	19
Morse Chain Co.	Back Cover
Mt. Vernon Car Mfg. Co., The	51
Mott Core Drilling Co.	59
National Carbon Co.	15
New Jersey Zinc Co., The (of Pa.)	41
Ohio Brass Co.	12
Oxweld Acetylene Co.	49
Patrick, R. S.	57
Pennsylvania Drilling Co.	59
Phelps Dodge Corp.	59
Phillips Mine & Mill Supply Co.	53
Roberts & Schaefer Co.	3
Robinson Ventilating Co.	55
Roebling's Sons Co., John A.	5
Rogers Iron Works Co.	26
Sewanee Fuel & Iron Co.	60
S. K. F. Industries, Inc.	25
Stonehouse Signs, Inc.	59
Timken Roller Bearing Co.	34
Tri-State Zinc & Lead Ore Producers Assn.	36
Tyler Co., The W. S.	8
Union Carbide & Carbon Corp.	43
United Iron Works, Inc.	46
Vulcan Iron Works	33
Webb City & Carterville Fdry. & Machine Works	30
Webster Mfg. Co., The	53
Westinghouse Elec. & Mfg. Co.	22
West Virginia Rail Co., The	57



Your conditions are different

Conditions are different at different mines. Differing conditions require individual study and adaptation of known factors to make haulage economical. It is our business to make mine transportation economical. Our booklet "Lower Haulage Costs Higher Net Profits" may give you helpful hints. Send for it.

ENTERPRISE WHEEL & CAR CORPORATION

Bristol, Va.-Tenn., Huntington, W. Va.

SALES AGENTS: Birmingham, A. J. Bowron; Bluefield, F. G. Phillips; Denver, O. H. Davidson; Hazard, Sterling Hardware Co.; Middlesboro, Rogan & Rogan Co.

To be sure

of accommodations that are satisfactory

at the Annual Convention of the American Mining Congress write promptly to the organization headquarters telling what you desire.

841 MUNSEY BUILDING WASHINGTON, D. C.

Our congratulations and best wishes

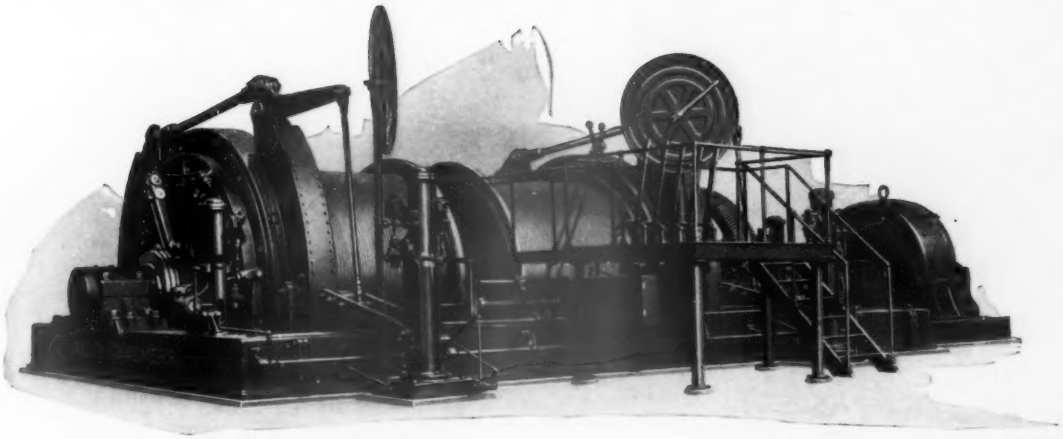
to

The Eagle-Picher Lead Co.

We have supplied for twenty years the coke they have required in the reduction of Lead and Zinc ores

SEWANEE FUEL & IRON COMPANY

COALMONT, TENNESSEE



Another

Allis-Chalmers Hoist ..

for the

Calumet & Arizona Mining Co.

Campbell Shaft ◆ **Bisbee, Arizona**

THIS is one of the largest hoists in the Southwest. It is built with welded steel plate drums, annealed, the latest feature in hoist design. A special arrangement in control permits four distinct hoisting speeds.

Specifications:

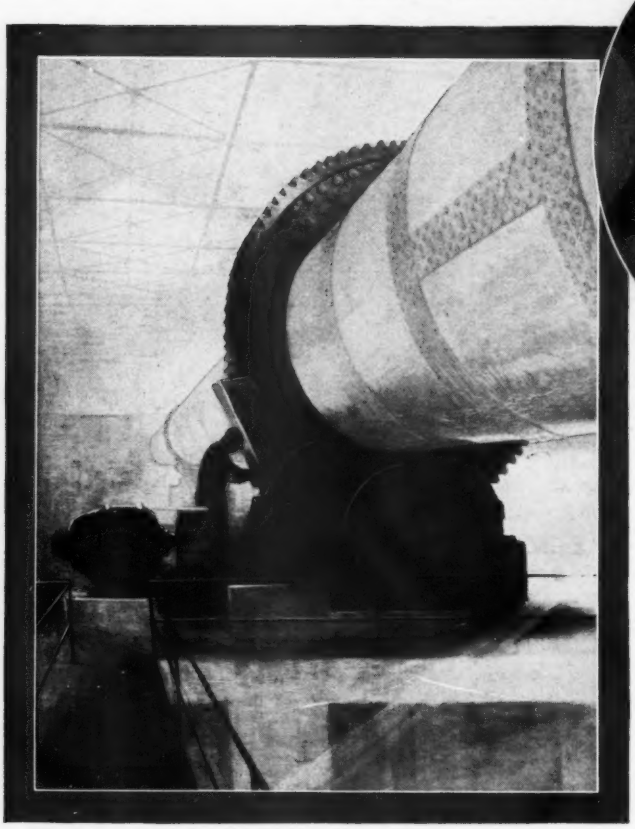
Maximum Rope Pull	32,000 Lbs.
Ore Hoisted per Trip	11,000 Lbs.
Diameter of Drums	10 Ft.
Face of Drums	7 Ft.
Amount of 1⅜″ rope wound	3800 Ft.
Hoisting Speeds	800, 1200, 1600, 2000 F. P. M.
Motor (Allis-Chalmers D. C.)	1350 H.P., 550 Volt
Motor-Generator Flywheel Set (Allis-Chalmers)	1250 KW.

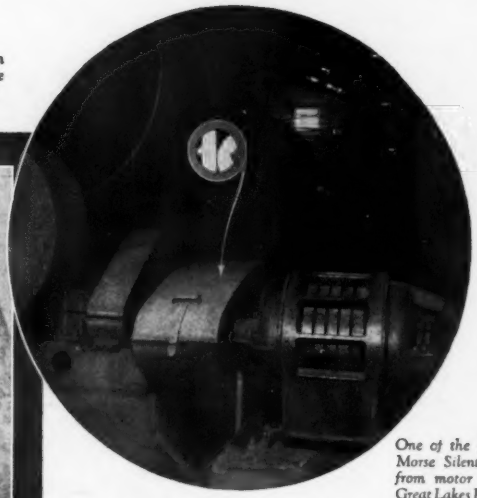
Your selection will be an Allis-Chalmers hoist if you wish the best. Allis-Chalmers engineering service is at your command.

ALLIS-CHALMERS MANUFACTURING COMPANY
MILWAUKEE, WISCONSIN

ALLIS-CHALMERS

The illustration below is a reproduction of an oil painting furnished through the courtesy of the General Electric Co.





One of the four 100 H. P. Morse Silent Chain Drives from motor to rotary kiln, Great Lakes Portland Cement Company

MORSE SILENT CHAINS

Drive the Largest Machines in the World

A single slip—a power transmission failure that would shut down one of the huge rotary kilns for one hour—would prove costly to the Great Lakes Portland Cement Company in lost production, time wasted, labor costs, and overhead. Since these machines normally operate 24 hours a day, 7 days a week, this company cannot afford to risk such failures. To prevent them they chose genuine Morse Silent Chains to transmit the power from electric motors to the four huge kilns, the largest machines in the world.

On power drives of from 1 H. P. to 5,000, where dependability and efficiency is a vital factor, genuine Morse Silent Chains are the choice of engineers everywhere. They give lowered overhead costs, increased production, and cut time charged off for shut-downs and repairs. They are silent, smooth in operation, and deliver a steady power flow of 98.6% for remarkably long periods. Their record of performance under every condition is most distinguished in the power transmission field.

If you want these advantages, and this money-making efficiency in your plant, Morse Silent Chains will give them to you. The Morse Engineer is always ready to consult with you on power transmission set-ups, and there is no charge for his services. For full information on Morse Silent Chain Drives, write today for the new data file. There is no obligation.

MORSE CHAIN CO., ITHACA, NEW YORK

Branches in Principal Cities

MORSE SILENT CHAIN 55 DRIVES

VISH

NOV

29

XUM